More than 27,000 Copies a Week

GENERAL LIBRARY
MAR 1920
UNIV OF MICH.

Electrical World

McGraw-Hill Company, Inc. New York March 27, 1920 Fifteen Cents a Copy

Materials for Line Construction and Maintenance

Poles, cross arms, pins, insulators, hardware, wire, tools —everything needed for your lines—can be promptly supplied by one of our 43 houses near you.

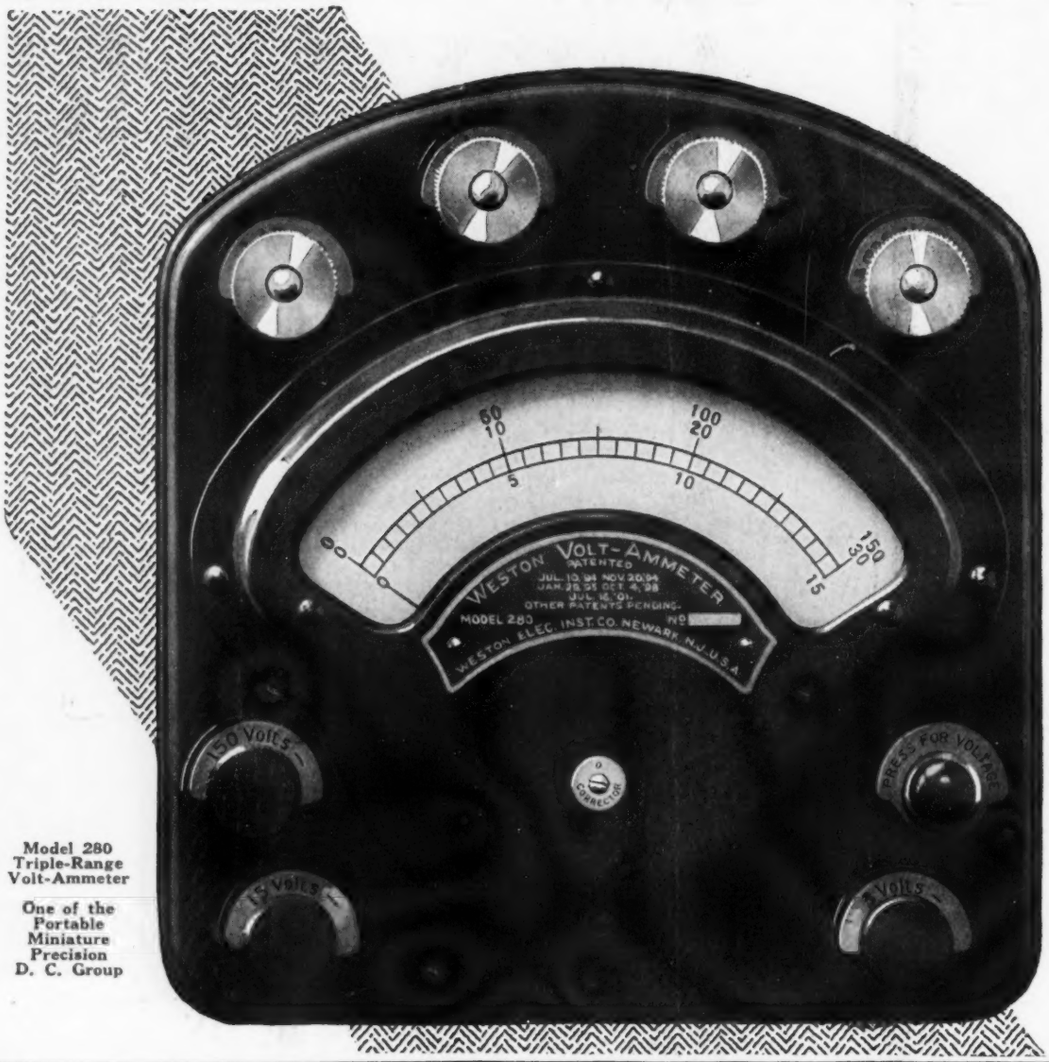
Specify "Western Electric" materials and you are assured of getting products which are backed by rigid tests, by standardized systems of inspection, and by reputation.

Western Electric Company

Offices in All Principal Cities

Western Electric

LINE MATERIAL



Model 280
Triple-Range
Volt-Ammeter

One of the
Portable
Miniature
Precision
D. C. Group

Weston

Electrical Indicating Instruments

are unqualifiedly superior in construction, accuracy and service to any other Instruments designed for the same purposes.

Weston models include complete Switchboard and Portable groups for service on A.C. or D.C. circuits, and also many Instruments designed for special purposes.

There is a Weston model for every electrical measurement need.

Consult the Weston representative in your nearest city, or write for Catalogs or Bulletins, specifying the field that interests you.

WESTON ELECTRICAL INSTRUMENT CO., 13 Weston Ave., Newark, N. J.

New York	Cleveland	Denver	Buffalo	Seattle	Winnipeg
Chicago	Detroit	Cincinnati	Minneapolis	Toronto	Vancouver
Philadelphia	St. Louis	Pittsburgh	New Orleans	Montreal	Calgary, Alta.
Boston	San Francisco	Richmond	Jacksonville	Halifax	

And in Principal Cities Throughout the World

Electrical World

The consolidation of ELECTRICAL WORLD, ELECTRICAL ENGINEER *and* AMERICAN ELECTRICIAN

Volume 75 — New York, Saturday, March 27, 1920 — *Number* 13

Distribution Losses

FUEL costs and plant limitations alike demand fresh attacks upon preventable line and equipment losses. Loads are shifting and increasing, and the adequacy of mains and feeders is no less important because new lamp designs, for instance, may be relieving the burdens of extremely close regulation of voltage. "Do it now" could never be applied with greater force in connection with the head for studies of all distribution losses than at present.

Revenue from Junk

ELSEWHERE will be found a brief account of the substantial savings made by a Pacific Coast company through the simple method of examining systematically, with a view to salvage, all material on its way to the junkman. There is money in the scrap heap along with all its other varied contents, and to distill it from the detritus needs no alchemy, only common sense, the business instinct and the capacity to take pains and see that subordinates do likewise.

Lighting-Fixture Styles

DESIGNS of home-lighting fixtures follow some of the eccentricities of changes in furniture styles. For 1920 the candelabra design predominates, and with it, of course, will come the use of bare round frosted-bulb lamps. These light sources in the line of vision are the rocks upon which the utilitarian engineer and the designer of artistic temperament have split. It is obvious that for 1920 at least the contentions of the artist have held more weight with the home-lighting fixture manufacturer than have the opinions of the engineer. Probably the engineer is to blame, because the artist has worked his way into the confidence of the manufacturer as one who can foresee the public's tastes. This is unfortunate even for the public, but the situation will be likely to remain unchanged until more engineers appreciate the value of learning how to sell an engineering idea.

Control of Credit

THE present period of business expansion could be suddenly turned into a panic if the banks were to curtail commercial credit. Speculative credit on the stock exchange has been curtailed, but commercial loans have been steadily increasing in spite of the warnings which have been issued in the guise of advances in the discount rates. This traditional method of controlling credit has not proved effective under present abnormal conditions because the profits have been large enough to do more than cover the higher interest charges. However, this period of inflation with its rising prices must give way to deflation with reductions in price levels. There are representative electrical manufacturers and bankers who believe that no appreciable slowing down of business is probable under the most adverse conditions for a considerable period, at least a year or more. However, every business man should observe all reasonable precautions and should be very sparing in the use of his credit privileges. The last annual report of the Federal Reserve Bank indicates that the board intends to check further expansion and to reduce inflation as rapidly as practicable. However, no drastic or precipitate action by the Federal Reserve Board seems imminent. Certainly the country at large has the right to expect this great credit agency of the government to display sufficient wisdom and foresight to bring financial conditions back to normal without any undue demoralization, non-employment or misery.

Competition in Service

THE oversold condition of many electrical markets by no means points to the enforced abdication of the salesman. Never is the opportunity to render customers valuable service greater than when a sellers' market rules the industry. Selection of goods and materials, scrutiny of specifications, influencing toward standardization, forecasting needs and outputs, intensive studies of performance of equipment and supplies—these and other lines of activity may be followed to mutual advantage. Competition in service supersedes rivalry for orders and establishes the foundation of long business friendships and profitable transactions.

Power Control by Commission

THE shortage of power in California due to unusual drought has brought out a very interesting situation. Seventeen utility companies have voluntarily met with the Railroad Commission of that state and pledged themselves to obey all rules, regulations and orders of the commission concerning diminution or extension of service and the interchange of power between the several companies. Another interesting sidelight has been furnished by farmers and power users who protest against a large block of power being transmitted from the northern section of the state to the central section, claiming that they should have first call upon the power generated in the district whence it originates. Thus the shortage of rainfall brings with it an unexpected compensation in the West, for it has caused a closer cooperative helpfulness in serving the public, a keener appreciation of the necessity for extending reservoirs to meet future emergencies, and, on the part of a grateful public, a full realization of the immense service that electrical energy is able to give in an exceedingly dry year to a rural community wholly dependent for its existence upon irrigation and electrical pumping.

Power-Plant Maintenance

MAINTENANCE of power-house apparatus is a prerequisite to successful operation. It really implies far more than casual repairs, for it ought to mean that, save for unusual contingencies, the plant is actually kept up to its initial condition with respect to efficiency and good service. It means more than keeping a plant merely in running condition, a conception of maintenance which has not infrequently led to disaster. Elsewhere in this issue A. B. Stitzer gives an admirably sound discussion of maintenance problems, particularly as to the orderly arrangement of affairs whereby proper inspection and the subsequent necessary upkeep can be successfully carried on. Of all things unfortunate in plant operation that which he refers to as deferred maintenance is most highly objectionable. In plain and uncompromising English, deferred maintenance means letting a plant run as long as possible before executing repairs long overdue. Those familiar with the development of the electrical art have no difficulty in remembering the unhappy effects of "deferred maintenance" in many early and some later electric railway systems, the results frequently being a large issue of capital stock for "improvements and extensions."

The only way to hold a power plant in condition and to give thoroughly first-class service is to keep looking after the details of the equipment all the time and to make at once any repairs or replacements that are found to be necessary. Orderly systematic inspection, with immediate reports of anything gone wrong, and prompt remedial action are imperative if service is to be maintained in the way that both the stockholders and the public have the right to expect. Perhaps the matter cannot be reduced wholly to standard methods, although Mr. Stitzer gives some very useful suggestions to this end. The chief thing is that inspection should be the immediate business of somebody with an orderly plan for reporting what has to be done and seeing to its prompt execution. One too often finds a fairly good system of outside inspection and a tendency to let things slide along in the station as long as may be convenient.

Self-Excited, Self-Starting Synchronous Motors

THE recognized advantage of the synchronous alternating-current motor over the induction motor is its good power factor. As a running machine the synchronous motor has qualities in this respect that are commendable in the eyes of central-station managers. The weak points of the synchronous motor are in starting or in accidental falling out of step. The starting torque of the synchronous motor is relatively small and has to be obtained at the expense of relatively excessive starting current. On the other hand, the induction motor can be designed to give excellent starting torque, and, if any momentary failure of voltage occurs in the supply system, it can easily regain full speed. Its power factor when running is apt to be low.

J. K. Kostko, in an article in this week's issue, advocates a synchronous motor with induction-motor characteristics. The machine recommended has no salient poles and resembles in its structure an induction motor with a somewhat wide air gap. The rotor is provided with a minor direct-current exciter winding, in addition to the main alternating-current motor winding.

The vector diagrams involved in the discussion of the properties of this advocated motor are interesting from a geometrical standpoint, in the fact that they are nearly all circular loci. The modern tendency of alternating-current motor theory has been to reveal the presence of circular vector loci in many directions previously unsuspected. The geometrical philosophy of these associated circular diagrams has in part been explained; but a complete and comprehensive exposition of the subject yet remains to be brought forth.

Hydro-Electric Developments in the West

PROGRESS in the development of plants in the Far West, as outlined in last week's issue, embodies elements of brilliant success and of discouraging obstacles. The growth of transmission systems began almost simultaneously in California and Colorado, the former furnishing light and power for miscellaneous purposes, the latter chiefly devoted to the general work of the mining camps. As time has gone on these regions have developed to no inconsiderable degree along the same lines. Fortunately there has been added the normal steady growth of prosperous communities and no inconsiderable call for power for irrigation as the farming country has developed. Unhappily some five years ago irrigation projects obtained a preferred rate, sound enough, perhaps, at the beginning, but now burdensome on account of the heavy increase in costs of operation and development. While some of the power companies through this region are not called upon to increase generating capacity at any considerable rate, there are others, in Montana and Idaho, for instance, where the proposed developments now under consideration aggregate more than 500,000 hp.

In California also there are bright prospects for the immediate future, owing to the rapid development of the industrial and agricultural sections of the state, of whose resources much that is claimed by the Californian is true. The brilliant success of the great networks of the Southern California Edison Company, the Pacific Gas & Electric Company and others stands out as the most remarkable development of power transmission in the world. California, too, has wisely given its power companies a square deal by allowing rates that encourage the investment of capital and the utilization of natural resources. These rates are not high, but fair, and they have resulted in putting transmitted power into every corner of the state. There are now under consideration several groups of high-head developments which will run close to 1,000,000 kw., and when one considers the territory of fertile lands to be irrigated and the other resources of the state, this great reserve of power will soon be needed.

The third group of hydro-electric activities are those in the far Northwest, Oregon and Washington. Here there has been a cessation of some great war activities which demanded large quantities of power, and there is a less favorable situation with respect to rate control. Existing plants do not lack in prosperity, but they are not now in a position to undertake large increases on account of the financial and rate situations. At the present time, with the very great increase in construction costs and operating costs as well, it does not require an ultra-conservative control of rates to put the brakes on activity. Several big projects are under way, but they may be slow of final realization. These considerations point very plainly the moral that the upbuilding of the hydro-electric resources of any region depends

on a reasonably generous policy toward the investor. The situation has changed radically in the last five years. Even the big and successful companies have to pay high for the capital they need for necessary improvements. All the costs have increased at a startling rate, and unless they are met by a modest rise in the price of the product sold progress must necessarily be checked.

Short-Circuit Currents in Networks

IN THE early days of electric light and power transmission the problem before the designers and constructors was to furnish the generators which could supply the load called for. In recent times, however, the amount of power that can be furnished by a large central station is so great that some safeguard has to be established against accidental short circuits in the system. If no check were established, a severe short circuit might not only develop an enormous amount of energy locally liberated but the mechanical stresses upon the generators and plant might easily become excessive. Sound generators have occasionally been wrecked from mechanical injuries due to stresses from a short circuit.

The protective devices which have been installed during recent years—permanent reactors, overload switches and time relays—are capable of checking the rush of current and energy into a short circuit when the conditions can be assigned in a simple and definite way. In the case, however, of a complex network of high-voltage conductors, such as exists in many large cities, the conditions under which a short circuit can occur are so complicated that it may be very difficult to predetermine whether the safeguards installed are adequate.

An interesting experimental method of ascertaining the electrical severity of a short circuit at any point of a given high-voltage system, supplied by any number of generators in parallel, is described this week by W. R. Woodward. It virtually consists in constructing an artificial line or system on an experimental switchboard supplied with a 110-volt generator. The switchboard artificial system can be short-circuited at any desired point, and the currents in the system or at the generators can be measured by inserting an ammeter at the corresponding points. A current of 1 amp. on the model may mean a current of 1,000 amp. in the actual system, the ratio being determined partly by the voltage supplied to the model and partly by the scale of resistances used in its construction.

An interesting feature of the artificial-line system is that, in the ordinary method of its use, resistances in the model represent reactances in the actual system. The resistance distribution in the actual system is ignored in the model. Consequently, if a short-circuit on the model involves a certain amount of current and power, with reactance only inserted, the added effects of resistance will tend to reduce somewhat the currents in the actual systems. The currents in the model are to that extent limiting currents. This procedure greatly simplifies the construction of the model, because if the latter had to be supplied with both resistance and reactance to match the actual system in all parts, the construction would become much more expensive, while the increased precision would ordinarily be of little service from a practical standpoint.

The switchboard artificial system also has the advantage that it lends itself to the modeling of any given city system with relatively little delay.

Another Stride in Railroad Electrification

THE 207 miles between Tacoma and Othello, Wash., added to the 440 miles previously electrified between Avery, Idaho, and Harlow, Mont., makes 647 miles of track belonging to the Chicago, Milwaukee & St. Paul Railway over which trains are now propelled by electricity. When the connecting link of 212 miles from Othello to Avery shall have been electrified, a straight run of 859 miles will be in operation. Here are both fulfillment and prophecy—fulfillment of a notable undertaking and prophecy of the day when water-power development will cause electric energy to supersede steam for traction purposes in many states—or even of the time when with the onward march of electricity locomotion by this means will be nation-wide.

Pond-Level Control Very Important in Low-head Plants

IRREGULAR flow has always been a problem confronting the hydraulic engineer, and particularly along the Atlantic seaboard, where the run-off is apt to be rapid and the available heads relatively small enough to make variation of pond level a serious factor. In the Rockies and on the Pacific Coast, where several hundred feet of head is the rule, the pond level as such causes very little variation of head and the main problem is to retain all the water possible. In the eastern part of the country, however, the hydraulic works must be so managed as to keep the level on the whole as high as possible, with due provision for taking care sometimes of enormous amounts of surplus water which cannot be saved in the area impounded and is likely to do much damage unless discharged into the stream. In last week's issue Earl Stafford analyzed the various schemes for accomplishing these ends, beginning with the old-fashioned flashboard and proceeding to the recent types of automatic swinging gates.

The flashboard is, of course, able to change the level by only a structurally fixed amount of a very few feet. Discharge of water in time of flood is accomplished by removing the flashboard; but the control of head thus obtained is very imperfect, for, with the original form of flashboard, it is merely a case of a dam with or without the boards. These work passably well, however, in big storage areas with small variations in head. The hinged flashboards pivoted on the lower edge and held up by props which can be removed readily when necessary form a further step in design but still represent only the crudest sort of regulation of the pond level. One step further along comes the sliding gate, effective but requiring hand regulation and in cold climates likely to get blocked by ice. Various forms of pivoted gates show some improvement over the sliding device, being more easily managed and less easily put out of action. Of late there has been a strong tendency to install swinging-leaf automatic gates hinged and counterbalanced so that the water pressure itself determines the angle at which the gate stands. These are now used up to large sizes, 8 feet or 10 feet (2.4 m. or 3 m.) high and 50 feet (15 m.) or more long, and when carefully balanced they seem to be exceptionally successful in holding a steady level in normal circumstances and meeting flood conditions successfully. Something of the detail of the installation costs and practical operation in saving water with these gates is given in Mr. Stafford's paper. Incidentally he deals with the methods for meeting ever-present ice problems in Northern plants.

Benjamin G. Lamme

An originator of methods for calculating designs of electrical machines, a leader in electric traction development and a prolific inventor

ALTHOUGH a graduate in mechanical engineering, Benjamin G. Lamme is one of our best known electrical engineers and has always devoted his attention to electrical problems. It was the late Albert Schmid who discovered Mr. Lamme's genius in the Westinghouse test room, where he began work on May 1, 1889. Although methods for calculating the performance of electric motors were then unknown, Mr. Lamme devised a means whereby the saturation curves of existing machines could be checked up from test data. In January, 1890, just eight months after taking up electrical work, he prepared specifications from calculations for a double-reduction railway motor which was built and placed on the market as a commercial machine. Then from his calculations in the fall of 1890 came the four-pole, single-reduction-gear railway motor with slotted armature, machine-wound coils and a wave or two-circuit winding—the design still standard in railway work. He has been a prolific inventor. Most of the early rotary-converter patents were in his name, and he alone is the father of the 60-cycle converter. The single-phase railway motor which was once said to be impossible also stands to his credit. To turbo-generator design and all Westinghouse alternating-current apparatus he has contributed much. Mr. Lamme has denied himself many honors owing to an extremely retiring disposition. His genius, however, has been widely recognized. Two years ago he was selected as chairman of the inventions committee of the Naval Consulting Board, and in June, 1919, the Edison medal was awarded to him by the A. I. E. E. for inventions and development of electrical machinery. His greatest reward, however, is the regard in which he is held by his engineering associates, many of whom he has discovered and promoted to high positions during the seventeen years he has been chief engineer of the Westinghouse Electric & Manufacturing Company.

Short-Circuit Currents in Networks

A Miniature Network Is Readily Set Up by Means of a Flexible Switchboard and Approximate Currents Are Measured—Typical Examples Are Worked Out

By W. R. WOODWARD
Electrical Engineer Westinghouse Electric & Manufacturing Company

THE interconnection of transmission and distribution systems in the last few years has resulted in networks of a very complicated form. This complication has increased the operating difficulties and has made necessary a more accurate knowledge of the happenings in the system as a whole when a disturbance occurs in any portion. Short circuits on such large power systems not only impose heavy duty on the oil circuit breakers but result in heavy mechanical strains in the apparatus in the circuit, such as transformers and busbars. It is, therefore, of the utmost importance to be able to calculate the currents that may flow in such a system during short circuit, in order to select the proper circuit breakers, to provide adequate mechanical strength in the various parts of the circuit and to adjust selective relays, so that the portion of the system in trouble may be cut free from the rest of the system with the minimum disturbance.

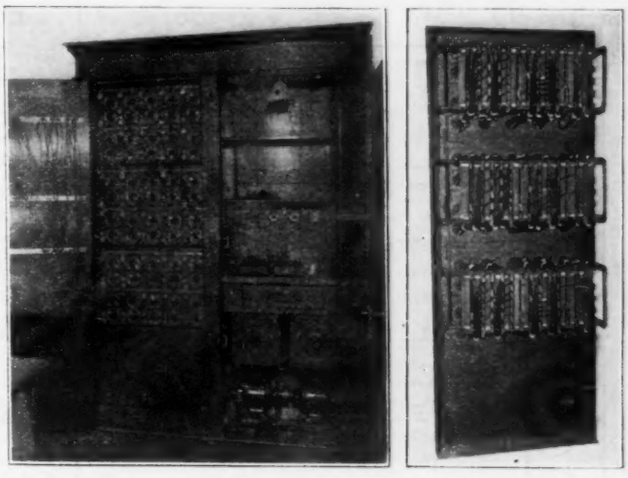
While it is possible to calculate the short-circuit current in most cases by the application of Kirchoff's laws, the process is often very laborious and the necessary time is not available, so that some means of lessening the labor is essential.

Miniature Network is Readily Set Up

This has been accomplished for a number of years, in the case of extremely complicated problems, by setting up a miniature of the networks, using uniform resistance wire, whose length is proportional to the reactances of the various circuits, and then measuring the resultant current in the various paths when a moderate voltage is applied. However, such a "set-up" is expensive and requires much time and labor. The problem can be greatly reduced, however, by arranging a set of permanent adjustable resistors in convenient form so that they may be connected into a miniature of any network. This set-up may be quickly made and the desired results obtained at very little expense and in a short time. Such a network involving only resistance when substituted for impedance or reactance, while not giving exact results, is adequate for most cases, and allowances can be made in almost any problem for the errors that are introduced by the neglect of the other elements.

This method can be justified as follows: In general, synchronous machines, transformers and aërial lines have similar impedance characteristics—that is, the reactance value is relatively large with respect to the resistance value. If these impedances have exactly the same power factor—*i.e.*, ratio of resistance to reactance—it is obvious that if resistance be substituted for impedance and direct voltage applied, the current flowing will be exactly proportional to the symmetrical alternating current which would flow in the case of short circuit. If they are not the same, some error is introduced. Usually the worst case of error is where underground three-conductor cables are used, in which case the reactance value is low in proportion to the resistance, particularly in 25-cycle systems. The network, however, can usually be checked quickly to determine whether an incorrect impedance in these lines would merely change the total current or would change the distribution of the current in the network. In the latter case it might lead to considerable error, but in general the effect of the cable impedance is rather small in those short-circuit conditions which are the determining factors in apparatus application.

For the calculation of regulation a device using resistance only can seldom be applied without more resultant error than can be allowed. In this work it is usually necessary to obtain results within a small limit of error,



FIGS. 1 AND 2—FRONT AND REAR VIEW OF CALCULATING BOARD

whereas greater limits are permissible in estimating short-circuit values of currents. Also, in the case of transmission lines, the value of capacity must be considered in calculating regulation, as it has a marked effect on regulation but a much less effect on short-circuit currents; for when a short-circuit occurs the voltage between wires or from wires to ground is much reduced.

How the Switchboard Is Arranged

On a calculating board recently developed for this work there are thirty adjustable resistors mounted on a panel of three frames with ten units per frame. Each resistor of 1,100 ohms is made in two parts, each part connected to an eleven-point dial. The first dial gives resistance values of 50, 100, 200, 300, etc., to 1,000 ohms, and is connected in series with a second dial which is adjustable from 0 ohm to 100 ohms in steps of ten. By the use of these two dials any resistance from 50 ohms to 1,100 ohms can be obtained in steps of ten ohms.

As shown in the accompanying illustrations, the units are mounted in two horizontal rows of five units each. A bus bar is provided at the top and bottom of the top row and at the top only of the bottom row. Each resistor ends in a terminal block which may be connected to the bus by means of a tapered plug. Several tapered

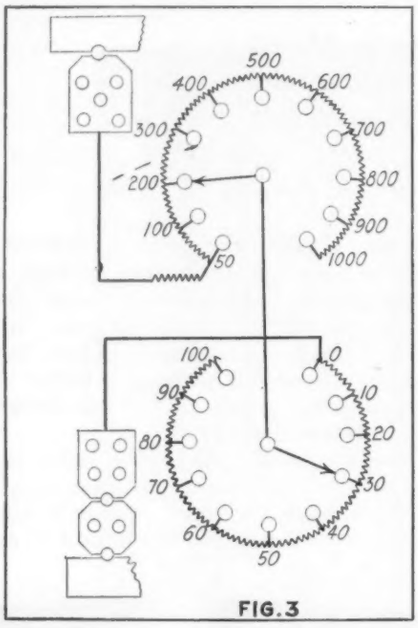


FIG. 3

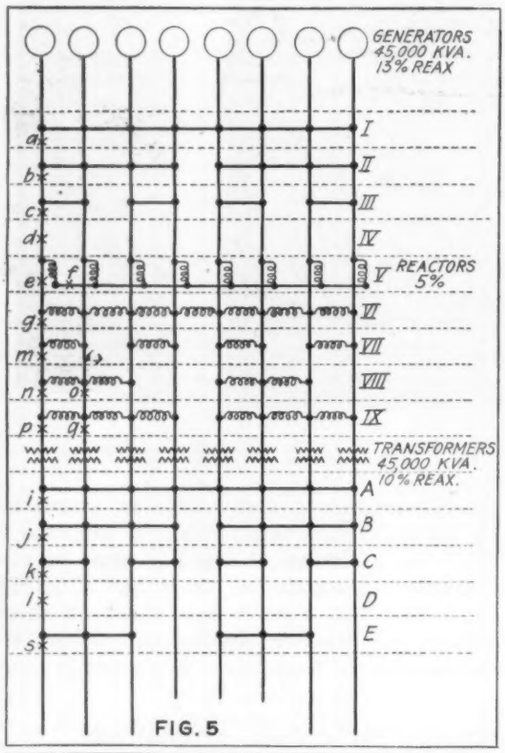


FIG. 5

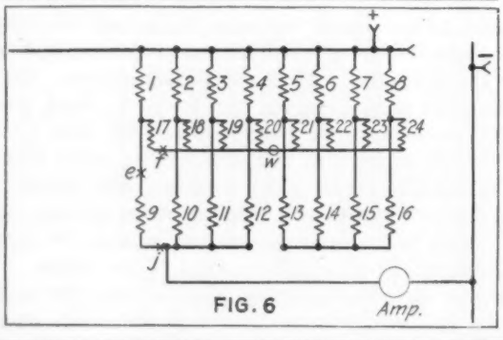


FIG. 6

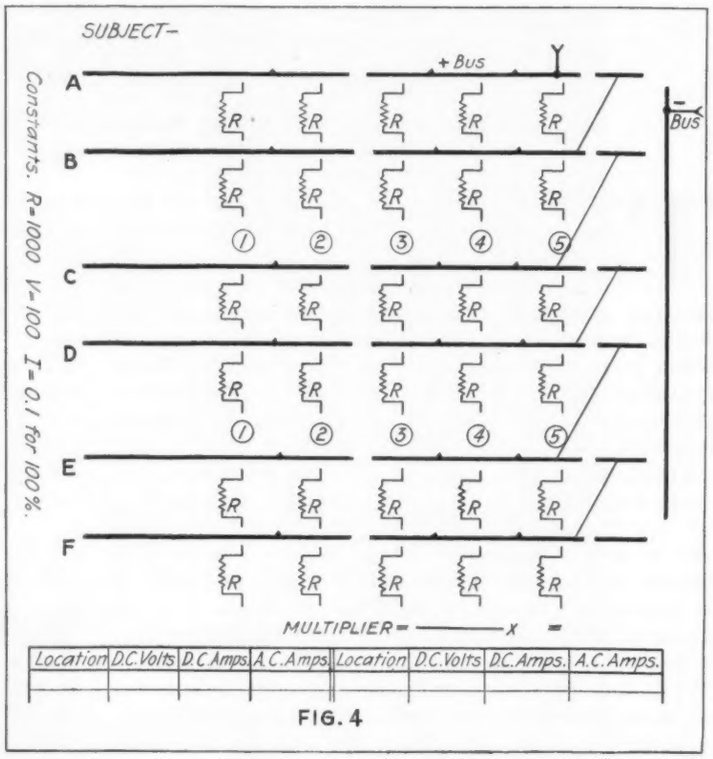
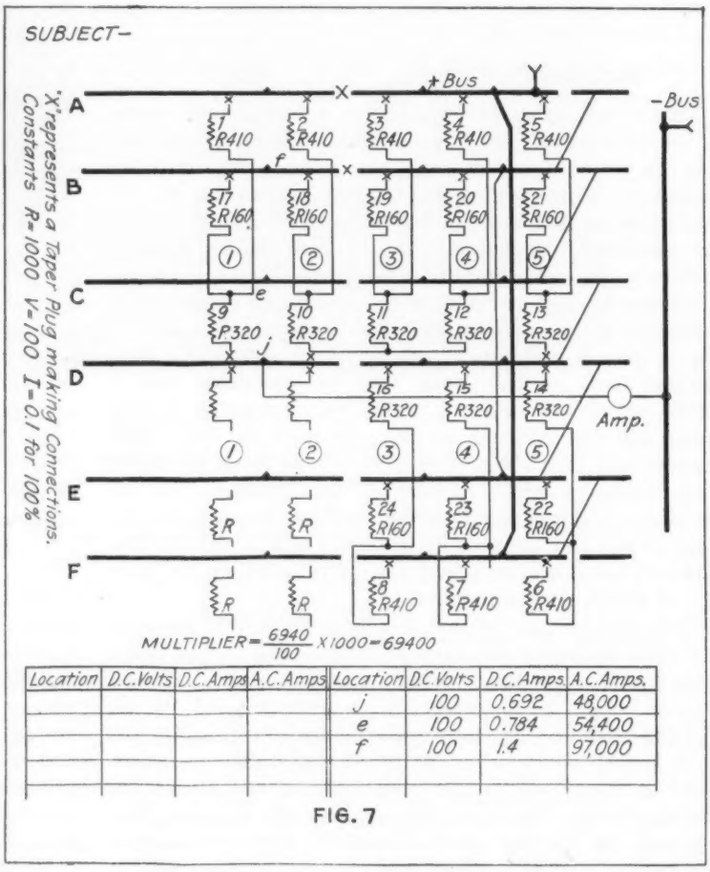


FIG. 4



Location	D.C.Volts	D.C.Amps	A.C.Amps	Location	D.C.Volts	D.C.Amps.	A.C.Amps.
				j	100	0.692	48,000
				e	100	0.784	54,400
				f	100	1.4	97,000

FIG. 7

FIGS. 3 TO 7—WORKING OUT THE SHORT-CIRCUIT CURRENT IN A NETWORK BY CALCULATING BOARD

Fig. 3—Diagram of one resistor on panel.
Fig. 4—Form used for laying out miniature circuits.
Fig. 5—High-voltage and low-voltage operating connections considered in problem.
Fig. 6—Simplified diagram of combination in Fig. 5 with short circuit at *j*.
Fig. 7—Set-up of panel for problem, Figs. 5 and 6.

TABLE GIVING TOTAL INSTANTANEOUS SYMMETRICAL SHORT-CIRCUIT CURRENT ON LOW-VOLTAGE SIDE.
BASIS 12,000 VOLTS

L.V. / H.V.	I All in parallel	II Two groups, four in parallel	III Four groups, two in parallel	IV Separate	V Reactance Synchronizing Bus	VI Reactance Main Bus	VII Four groups, two in parallel, Reactance Main Bus	VIII Two groups, three in parallel, Reactance Main Bus	IX Two groups, four in parallel, Reactance Main Bus
A All in parallel	a 135,000	b 92,500	c 59,500	d 33,400	e 56,000 f 97,000	g 51,800 h 66,500	* 48,400	x 58,000	x 62,000
B Two groups, four in parallel		b 68,500	c 48,000	d 29,400	e 54,400 f 97,000	g 45,000 h 64,000	* 39,200	x 47,000	x 49,300
C Four groups, two in parallel			c 34,200	d 26,300	e 51,300 f 97,000	g 39,700 h 59,000	m 29,500	n 36,200 o 44,800	p 37,900 q 47,500
D Separate				d 17,200	e 46,500 f 97,000	g 37,200 h 56,400			

HIGH-VOLTAGE SIDE. BASIS, 12,000 VOLTS

A All in parallel	i 75,500	i 75,500	i 75,500	i 75,500	i 75,500	i 75,500	i 75,500	i 75,500	i 75,500
B—two groups, four in parallel	j 54,500	j 38,400	j 38,400	j 38,400	j 48,000	j 44,000	j 37,600	j 37,600	j 37,600
C—four groups, two in parallel	k 32,800	k 26,600	k 19,300	k 19,100	k 48,000	k_1 24,000 k_2 27,000	k 18,800	k 21,100	k 23,200
D—separate	l 18,700	l 16,400	l 13,300	l 9,350	l 15,000	l_1 14,000 l_4 16,000			
E—Two groups, three in parallel							s 32,100	s 28,300	s 36,800

* Maximum short-circuit current on low-voltage side.

holes are also provided in each terminal and busbar for the insertion of jumper plugs. Each busbar is divided into two parts which may be connected by a tapered plug, and two adjacent busbars may also be connected by the insertion of a plug. One section of the top bar is permanently connected to the positive generator lead, and the negative lead of the generator is connected to the negative bus, which for convenience is placed at one side and extends from the top to the bottom of the board.

Energy for this outfit is supplied from a 500-watt, 120-volt motor-generator adjustable so as to produce voltages of 50, 100 or 120 with current up to 5 amp. A low-reading ammeter is arranged with flexible leads, so that it may be readily connected in series with any resistor. For this purpose the lower terminal of each resistor is split into two parts and connected by a tapered plug around which the ammeter may be shunted. Owing to the high resistance of the units the contact and ammeter resistances are negligible. The complete panel is mounted in a wooden cabinet for protection, the motor-generator and field resistance boxes being mounted under the instrument table.

How to Operate the Board

In Fig. 3 the connections of an individual resistor unit are shown. The resistance cannot be adjusted to less than 50 ohms in order that there shall be no danger of over-loading the generator. The diagrams of the board as shown in Fig. 4 are used in working out any individual problem.

It is necessary to draw a single-line diagram of the network and reduce the impedance of every circuit to ohms on a common voltage basis. On a three-phase circuit the impedance is taken as the equivalent from line to neutral. The following indicates how these impedances are calculated.

For example, assume a 10,000-kva., 11,000-volt, three-phase generator having 12 per cent reactance. The full load current is $10{,}000 \div (11 \times 1.73) = 526$ amp. The reactance drop $= (0.12 \times 11{,}000) \div 1.73 = 762$ volts. The impedance $= 762 \div 526 = 1.45$ ohms.

If apparatus of some other voltage is connected to the network by transformers, its impedance may be calculated as above just as though it were really rated at 11,000 volts. If for any reason its actual value in ohms is known, as for instance in the case of a transmission line, it may be reduced to the proper voltage basis by multiplying by the square of the ratio of the desired to the actual voltage. Thus a 33,000-volt transmission line has 12 ohms reactance. Its equivalent reactance on the basis of 11,000 volts is $(11/33)^2 \times 12 = 1.33$ ohms.

For convenience, the values in ohms are multiplied by a factor (M) to obtain values in the range of 50 to 1,100, which are the limits of actual values of the resistors. For example, suppose the actual reactance ohms range from 0.34 to 3.9 ohms; multiplying by 200 we get values from 68 to 780.

The individual impedances are numbered on the single-line diagram of the network and the connections shown on the form, each resistor being numbered and its value recorded. The set-up on the panel is then made exactly as shown on the sketch to facilitate checking.

By applying a direct-current voltage and measuring the current to the various branches a value proportional to the alternating current is obtained. This value multiplied by a factor (K) gives the value of symmetrical alternating current, where $K =$ (alternating-current volts to neutral $\times$ M) $\div$ direct-current volts.

Solution of a Specific Problem

A good example of the usefulness of this equipment is the problem and results shown in Figs. 5, 6, 7 and 8. This involves a new project which will ultimately contain eight generators, each rated at 45,000 kva., 13 per cent inherent reactance. The transformers of the same rating have 10 per cent inherent reactance, while the bus reactors were assumed as 5 per cent on the basis of the rating of one machine. The problem was to ascertain the best scheme of operating such a station. Fig. 5 shows the various high-voltage and low-voltage operating connections considered, while Fig. 6 is a simplified diagram of combination in Fig. 5 with short circuit at point j. The generators are numbered 1 to 8,

the transformers 9 to 16 and the synchronizing reactors 17 to 24. The actual impedances of the apparatus are: Generators, 0.415 ohm; transformers, 0.32 ohm; reactors, 0.16 ohm. These were multiplied by $M = 1{,}000$, giving values of 415, 320 and 160 respectively.

Since all generators tend to feed into a short circuit, they are connected to the "plus" bus and the point of short circuit connected to the "minus" bus. An ammeter in the negative bus connection shows the total short-circuit current at *j*. If desired, the ammeter can be connected at some other point, such as *w*, to find how much certain machines are contributing to the total current.

Fig. 7 shows the connections drawn on the form Fig. 4, with the impedances numbered as in Fig. 6 and impedance values given.

The tabulation shows the various values of short-circuit currents corresponding to the various connections and places of short circuit. From this table the effect of the various connections on bus structure and circuit breaker rupturing capacity can be thoroughly analyzed.

Standard Maintenance in Power Plants*

Deferred Maintenance Shown to Be an "Expensive" Economy—Systematic Inspection and Repair Program Is Suggested—Relation Existing Between Maintenance and Reserve Capacity Is Pointed Out

By A. B. STITZER
Chief Engineer Republic Engineers, Inc.

SOME engineers have always believed that maintenance of the highest character justified the expense involved, but the majority have looked upon it as a necessary evil attendant upon operation. The latter group do only a sufficient amount of maintenance work to keep the plant in operating condition and rely upon reserve capacity to care for the unforeseen outrages and emergency use. Higher standards of maintenance are conducive to the elimination or reduction of losses from a number of sources.

Authorities differ on what really constitutes maintenance, but it is usually referred to as the expense of keeping a plant in running condition over and above the cost of attendance. It includes the cost of up-keep replacement and precautionary measures. This latter item includes renewal of working parts, painting of perishable or exposed material and replacement of worn-out and defective equipment.

DEFERRED MAINTENANCE IS COSTLY

Deferred maintenance is the real "bugbear" of power plants and is represented by the cost of putting the plant in the best practical working order at any given time. A new plant may be kept running for several years with comparatively little maintenance, but during that time deferred charges are accumulating that must eventually be met. Repairs and renewals must then be made simultaneously on a large amount of equipment, thus impairing service and sending the cost of maintenance suddenly skyward. A striking example of the effect of deferred maintenance is shown graphically in Fig. 1, the data being taken from actual cost records. The plant from which this data was taken began operation in 1913, and for the succeeding four years only sufficient maintenance was applied to keep it running. In 1918, or the fifth year, however, it became necessary to begin overhauling the entire plant, and the maintenance charges jumped to 260 per cent of those for the preceding year and were more than six and one-half times the charges for 1916. There are few engineers who do not concede the fallacy of deferred-maintenance practice, and yet, strange to relate, there are also few who have had the courage to eliminate the evil.

The extreme limit of maintenance, of course, would be to keep the plant continuously in a new state, but

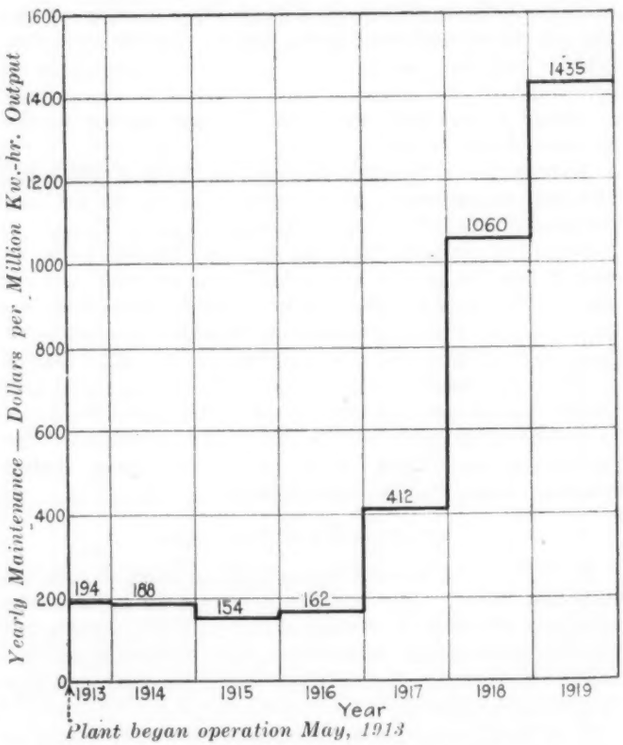


FIG. 1—EFFECT OF DEFERRED MAINTENANCE IN A MODERN POWER PLANT

since such a condition could only exist in theory, some practical limit must be established by investigation and experience. Even then, however, maintenance is not to be applied indiscriminately; to become a real economy it should be efficiently standardized.

There are two distinct divisions of such work, the first being a combination of inspection and record keeping, the second consisting of repairs and renewals.

*Presented before station operating committee, Ohio Electric Light Association.

There can be little doubt that many costly failures have been directly attributable to improper or insufficient inspection. A specific instance which occurs to the writer was one in which the field circuit of a 150-hp. direct-current motor was accidentally opened, allowing the motor to run away. In the ensuing wreck a piece of flying débris struck and killed a station attendant, while another piece cut through some brass pipe carrying three-phase, high-voltage cables. A severe "short" occurred, starting surges which shut down the entire system at an important hour of the day. This disastrous accident could, in all probability, have been avoided by proper inspection, since an investigation disclosed the fact that a field wire had been gradually "chafing" through because of excessive vibration.

Systematized, efficient inspection and records should be the basis of maintenance, and the elaborateness of the work should agree with the size and importance of the plant.

The following scheme, modified to suit local conditions, represents one way in which the matter could be handled. The first essential is *periodic* inspections, the frequency of which will vary according to the type of apparatus and the purpose for which it is used. All equipment in any given power plant would be divided into groups corresponding with the name of the apparatus, and then further classified according to the approximate number of inspections necessary during any definite period of time. This is practically dependent upon the amount of use the apparatus is likely to have during the selected period, and the final classification will be under daily, weekly, semi-monthly, monthly, bi-monthly, semi-annual and annual inspections. Experience will perhaps show that it is advantageous to make occasional changes in the classifications.

In order to facilitate inspection and at the same time to eliminate the probability of omitting some apparatus or important part thereof printed forms can be used advantageously and kept as permanent records. These forms may consist of a series of questions, which, if carefully answered by a simple yes or no, will necessitate a most rigid and thorough inspection. While paper forms are cheaper, the card file system is preferable, and the ease with which the latter may be kept should compensate for the additional first cost. A form can be made for each piece of apparatus or part of station equipment. Ordinarily a card would cover the inspection of a single piece of apparatus, but where the form is exceedingly short or several pieces of apparatus are closely related two or more forms could be combined on a card. Space can be left on each card for "Remarks," under which heading a detailed description of any trouble or defects may be noted and recommendations made for the elimination of the trouble or for repairs and renewals.

Consecutive numbers could be assigned to all apparatus scheduled to be inspected at any given time—say, for instance, the monthly inspection—and cards covering the inspection numbered accordingly. This consecutive numbering would be a further precaution against omitting some apparatus. It would also be advisable in numbering the apparatus to pay particular attention to the actual physical location in the station, making the numbers progressive from one part of the station to another instead of proceeding at random.

As soon as trouble is discovered the inspector should immediately turn in the card covering the case to the man in charge of the station or of maintenance. Then so long as the trouble is uncorrected the card should remain in a special file prominently displayed. When the defect has been remedied the card can be transferred to the regular file containing records of apparatus in good condition. The man in charge of maintenance can arrange the cards in the special file in the sequence in which it is most advisable to make repairs or renewals, since it is obvious that, owing to questions of expense, service or inability to obtain material, it is not always possible to make immediate corrections. Small repairs are nearly always allotted to Sundays or hours of "off peak." Occasionally the recommendations of the inspector may be changed or deemed unnecessary, in which case the card is so marked by the responsible party.

The fact must not be lost sight of that with many types of apparatus the periods of inspection may be shortened as the apparatus grows older. Many good systems of periodic inspection have been put in the discard because of this oversight.

It is obvious that no schedule can be made for emergency repairs, neither can any maintenance schedule be made which can be followed in detail just as laid out. Emergency conditions must be met as they arise with as little interruption to the actual schedule as possible. Likewise, slight repairs to equipment which should be made but which are not considered as emergency conditions may be made at periods of light load when such apparatus can be taken off the line without interfering with the necessary capacity required for carrying the load.

When emergency repairs are made good judgment must be used at the next regular period for inspection as to how nearly the repairs constituted a complete overhauling; otherwise the purpose of the schedule will be defeated, for it is highly probable that in most cases the inspection could be omitted.

Inspection periods being based entirely on estimated average use, the contention may arise that periodic inspection does not adequately provide for the fact that the actual hours' use of some apparatus varies continuously over a wide range. Again, it is possible that through unforeseen conditions some equipment might either be driven much above rating or else remain idle for an undue length of time between inspection dates. To offset this apparent disadvantage, it is suggested that charts be used in all special cases, showing continuously the numbers of hours' use of *rated* capacity. These charts will have the additional advantage of showing at a glance all apparatus nearing the time of inspection. If too much equipment is apparently coming due at the same time, the operator has the opportunity of slowing up or hastening some of it so that the minimum amount of apparatus will be out of service simultaneously.

However, it really makes little difference whether inspections are determined by definite periods or by hours' use, so long as a standard system is used.

Operating men should always be on the lookout for small deficiencies of apparatus and report them promptly so that if possible they can be put on a work list for that piece of apparatus when it comes

out of service. This is a sort of double insurance that nothing will be overlooked in the regular inspection. Co-operation between the operating and maintenance departments is very desirable in the working out of a maintenance schedule and also in carrying out the schedule after it is in effect.

Repairs and Renewals

It is an extremely difficult matter to prescribe a definite set of rules governing the exact amount of wear or deterioration which should take place before renewals are made; also the amount of elaborateness of repairs necessary at any given time. These things are in most cases a matter of judgment for the inspector, who should always be a carefully trained and experienced man.

The observation of inspection records, however, should furnish a satisfactory approximate guide in recommending renewals and repairs. If the records

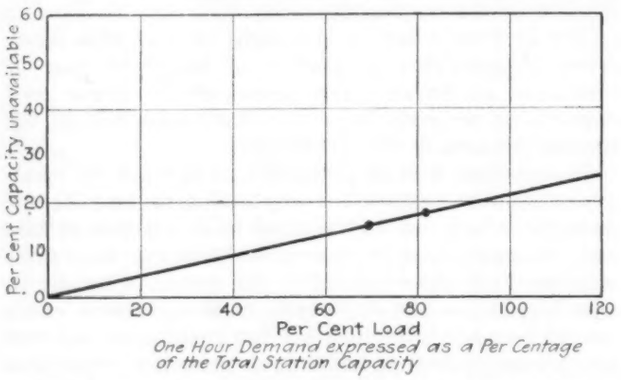


FIG. 2—VARIATION OF UNAVAILABLE APPARATUS WITH LOAD ON STATION

are complete, they will show the condition of any given piece of apparatus and its parts at each inspection; also the repairs and renewals made either at times of inspection or in emergency cases. Knowledge of this character covering a number of inspections should usually prove sufficient to determine the advisability of making immediate renewals or of postponing them until a subsequent inspection.

The foregoing suggestion, if conscientiously carried out, will automatically fix the point of best economy, which lies somewhere between the theoretical upper limit of maintaining everything in a new condition and the lower limit of allowing apparatus or parts thereof to fail before making repairs and renewals.

It very often happens that necessary maintenance work is neglected or postponed because of overloaded plant conditions or through a false idea of economy, but in either case a resulting failure is likely to cost a good deal more in loss of service as well as money than the cost of proper maintenance. A typical instance of an attempt to economize on necessary repairs and renewals which had serious results was one in which the boilers of a certain plant were permitted to reach such a bad condition that the slightest forcing caused excessive foaming. Quantities of scale and sediment and slugs of water were sent over into the turbine, and the inevitable shutdown occurred with much damage to the turbine and considerable loss of service.

In regard to the authorization of expenditure as well as a proper accounting for maintenance, the work-order system appears to be both simple and efficient. Under this plan a work order should be applied for two or three days prior to the regular overhaul period for any given piece of apparatus, but before making application the foreman in charge should check up the availability of the machine and also ascertain whether all necessary material for the work is on hand.

The great diversity of conditions affecting maintenance in the various power plants precludes any accurate estimate of the cost. An approximate idea may be had, however, from the fact that in a plant of 100,000 kw. capacity, where the maintenance is highly standardized, the charges for 1919 were 15 per cent of the total operating cost. These charges included inspection, record keeping, repairs and renewals.

Relation of Maintenance to Reserve Capacity

Reserve capacity in a power station is very often overlooked as a factor connected with maintenance of station equipment, the common idea being to consider reserve capacity as just so much insurance against interruptions to service during periods of emergency breakdown. Contrary to this belief, standardized maintenance does have a certain definite relation to reserve capacity.

The curve shown in Fig. 2 was determined from actual data collected during four years in several stations of a prominent company, and it shows the percentage of capacity unavailable under varying load conditions. The unavailable capacity represents that portion of the equipment necessarily out of service for emergency repairs and for the purpose of carrying out a system of standardized maintenance. The per cent load is the one-hour demand expressed as a percentage of the total rated capacity of the station. This ratio is sometimes known as "plant factor." Referring to the curve, it will be seen that, at 70 per cent load, 15 per cent of the capacity is unavailable owing to maintenance conditions, leaving 15 per cent reserve capacity. Two important facts are brought out by this curve—first, that maintenance varies directly with the rate at which the station is driven, and, second, that the maximum load possible would be about 82 per cent of the rated capacity of the station, the unavailable capacity at this load being 18 per cent.

The number of units in a station has an important bearing on standardized maintenance—a large number of small units being better for this purpose than a small number of large units. The general economy of the latter arrangement, however, makes it the most used, and for this reason perodic inspection becomes considerably more difficult to put into practice. In most cases the taking of a large unit out of service for inspection will seriously reduce or even eliminate reserve capacity.

It has often been said that more reserve capacity will be required with a system of standardized maintenance than without it. This, however, is an arbitrary viewpoint, since for any given factor of safety against interruptions to service it is evident that proper maintenance will reduce the necessary reserve capacity.

In the second part of this article a number of systems of maintenance used by representative companies will be given.

Measurement of Power Factor for Rates

Average Power Factor May Be Obtained Over Period of Time by Using Standard Watt-Hour Meters Connected to Register Energy and Reactive Components of Load

By C. E. BROWN
Commonwealth Edison Company, Chicago

THE desire on the part of central stations to incorporate power-factor clauses in rate schedules has directed a great deal of attention to the problem of measuring the power factor of customers' loads. There appears to be no generally accepted practice of making and recording power-factor measurements on three-phase loads over a period of time, and some of the methods commonly used are not accurate on unbalanced loads. A method has been developed, however, which has been found to make accurate measurements on customers' loads under various conditions met with in service.

This method was described in part by Willard S. Wilder on page 239 of the Aug. 2 issue of the ELECTRICAL WORLD. It requires no special equipment and is generally not difficult to apply. The method consists in the measurement of the reactive component of the load and the calculation of the power factor from the relation of this component to the energy as measured by the service meter. The scheme has been used by the Commonwealth Edison Company, Chicago, for the past year on three-phase loads of all degrees of unbalance to the extreme conditions where the load consists at times of a single-phase load across the two phases of the three-phase line. The results obtained have been uniformly accurate throughout, under balanced voltage conditions on the line.

A standard polyphase service meter with cross-phase connection of its potential coils will register $2EI \sin \phi$, or 115.5 per cent of the reactive component of a balanced three-phase load. Such a connection, however, does not give the reactive component accurately on unbalanced loads, which are of equal importance.

In the ELECTRICAL WORLD, Vol. 71, page 140, E. S. Borrington describes a method for determining the power factor on balanced loads. It is believed, however, that the method used by the Commonwealth Edison Company for the past year offers greater advantages and has a wider sphere of application.

In this method a standard polyphase service-type meter is used to register the reactive component of the load. The meter is connected with its current coils in series with the corresponding current coils of the service watt-hour meter, and its potential coils from one phase to the middle or half tap on the secondary of the potential transformer connected across the other two phases. This connection is made in such order that the potential on the reactive component meter is 90 deg. behind the phase of the corresponding element of the service meter, as shown in the diagram of connections (Fig. 1). An inspection of the vector diagrams in Fig. 2 will show that the voltage on the reactive component meter is 86.6 per cent of the voltage across the potential transformer and the registration is $1.5EI \sin \phi$, or 86.6 per cent of the reactive component. This may be demonstrated in the case of balanced loads as follows:

Let E' = the potential from A' to C = $0.866E$,
also E' = the potential from A to B' = $0.866E$,
I = current per phase;
then, for the upper element of the meter:

$$\text{Reg.} = E'I \sin(\phi + 30°) = 0.866EI \sin(\phi + 30°),$$

and for the lower element:

$$\text{Reg.} = E'I \sin(\phi - 30°) = 0.866EI \sin(\phi - 30°),$$

and for the meter as a whole:

$$\begin{aligned}\text{Reg.} &= 0.866EI[\sin(\phi + 30°) + \sin(\phi - 30°)] \\ &= 0.866EI(2 \sin\phi \cos 30°) \\ &= 1.5EI \sin\phi.\end{aligned}$$

The accuracy of these meter registrations on unbal-

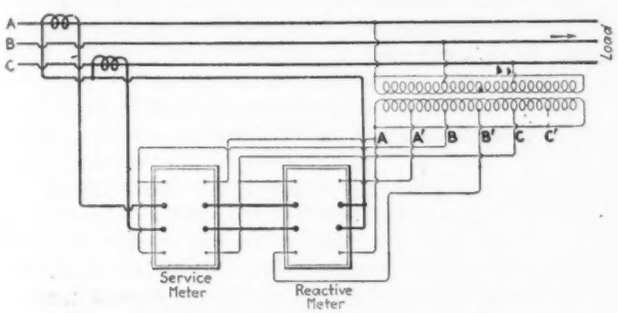


FIG. 1—POWER FACTOR OBTAINED FROM SERVICE METERS
Commonwealth Edison Company, Chicago
Standard three-phase watt-hour meters connected to indicate energy and reactive components of load with delta-connected potential transformers.

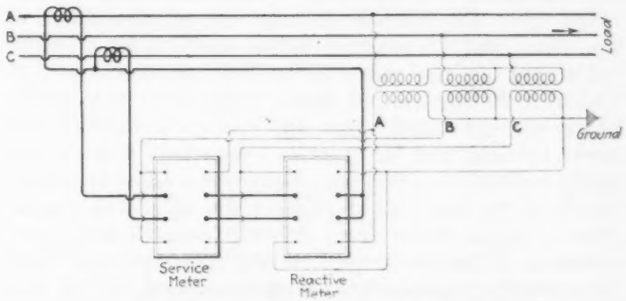


FIG. 3—MODIFICATION OF FIG. 1 FOR USE WITH Y-CONNECTED POTENTIAL TRANSFORMERS
With meters connected as in Figs. 1 and 3 the sum of the energy (P) and reactive (X) components of different loads make the same triangle (OLM, Fig. 4) as if all the service were supplied through one meter.

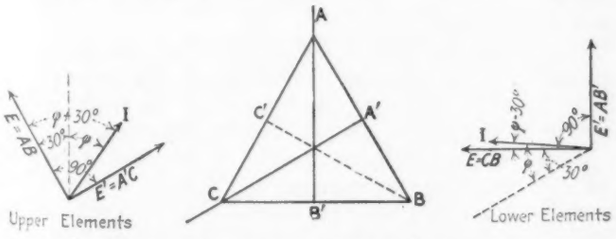


FIG. 2—VECTOR DIAGRAMS OF VOLTAGE RELATIONS IN SERVICE AND REACTIVE METERS (FIG. 1)
AB and CB (E) are the voltages across the elements of the service meter, and $A'C$ and AB' (E') are the potentials on the reactive meter.

anced loads can be demonstrated mathematically, but the following analysis will answer equally well: Referring to Fig. 2, it is evident that any three-phase load may be considered as made up of three single-phase loads connected from *A* to *B*, *A* to *C*, and *B* to *C*, respectively, and that these single-phase loads will be equal or unequal according as to whether the three-phase load and power factor is balanced or unbalanced.

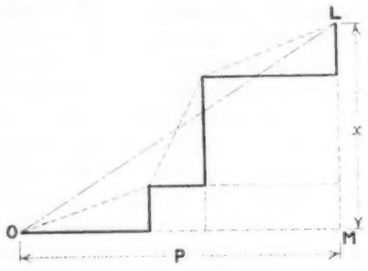


FIG. 4—RESULTANT POWER FACTOR OF TWO OR MORE LOADS

The reactive component of any single-phase load can be measured by connecting the current coil of a meter in series with it and the potential coil to a potential 90 deg. out of phase with the potential to which the load is connected. Applying this principle then and dividing by the factor 0.866, the single-phase current taken from *AB* will pass through the upper element of the meter and its reactive component will be correctly registered as the potential of this element is *A'C*, which is 90 deg. out of phase with *AB*. The single-phase current taken from *BC* will pass through the lower element and its reactive component will be correctly registered as the potential on this element is *AB'*, which is 90 deg. out of phase with *BC*. The single-phase current taken from *AC* will pass through both elements of the meter and its reactive component will be correctly registered since the resultant of the two potentials acting is equivalent to the potential *BC'*. which is 90 deg. out of phase with *AC*.

No assumption of equality of relative values of current or power factor has been made, but the voltage triangle must remain symmetrical. This means that the method is correct for any degree of current or power-factor unbalance but not for unbalance in potential. But the unbalance in the potential on commercial lines is very much less than the unbalance in current may be and will not generally cause any appreciable error. The fact that two of these currents are usually acting on each element at the same time does not, of course, invalidate these conclusions.

CALIBRATING AND CONNECTING THE METERS

The reactive component meter is calibrated on 86.6 per cent of normal voltage and can be adjusted with a disk constant of 86.6 per cent of normal so that it will register the reactive component without correction. The meter is left in circuit for a week or more, as may be required, or it can be connected up permanently if continuous records are needed. When it is desired to know the power factor at the time of the maximum demand or for other short periods of time printometers are connected to the reactive meter and to the service meter in the same manner and at the same time. This permits the determination of the power factor at any hour of the day, under any conditions of load, and permits plotting a continuous power-factor curve.

The power factor is calculated from the registration of the two meters in the following manner:

$$\frac{\text{Reactive kva.-hr.}}{\text{kw.-hr.}} = \frac{\sin}{\cos} = \tan \phi.$$

The power factor is the cosine of the angle whose tangent is obtained by dividing the registration of the reactive component meter by the registration of the service meter.

The connecting up of the standard service meters as suggested is not difficult under practically any condition met with in practice. The potential transformers used on high-potential metering are all provided with middle taps on the secondary, and the only extra wiring required is that necessary to connect these taps to the meter panel. Where no potential transformers are used a middle tap can be taken from any double-coil power transformer without great difficulty. Where potential transformers are connected Y, or where no potential transformers are used and power transformers are connected Y, the reactive meter can be connected according to diagram shown in Fig. 3. The potential on the meter will then be that of the secondary of the transformer, and the registration will be 57.7 per cent of the reactive component. This method is available for the measurements of power factor on single-phase loads taken from three-phase circuits, the single-phase reactive meter being connected with its current coil in series with that of the service meter and its potential coil 90 deg. behind. The potential on the reactive meter is 86.6 per cent of normal, and its registration is 86.6 per cent of the reactive component.

The power factor of single-phase loads taken from three-phase circuits can be obtained by connecting the potential coils of a test meter to one of the other phases in cases where the middle tap is not available. A standard single-phase service-type meter is used and is connected with its current coil in series with the current coil of the service meter, and its potential coil to the phase having a potential 60 deg. behind that of the service meter. This will give a forward rotation on lagging currents, and the ratio of the test-meter registration to that of the service meter will vary with the power factor as shown in Fig. 5. This is essentially the Borrington method applied to single-phase circuits, and the accuracy of results obtained is not materially different from those obtained with a 90-deg. connection. As this test meter is only 60 deg. out of phase with the service meter, it does not record reactive component; but if the reactive component is required it can be obtained by multiplying the registration of the service meter by the tangent of the angle whose cosine is the power factor already obtained.

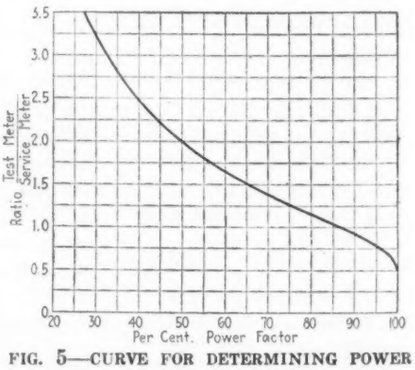


FIG. 5—CURVE FOR DETERMINING POWER FACTOR FROM TWO WATT-HOUR METERS CONNECTED 60 DEG. OUT OF PHASE

When the mean power factor of the load measured on several meters is required the several energy components are added and the several reactive components, and from these combined results the power factor is calculated in the same way as for a single meter. This gives a vector power factor as shown in Fig. 4, and the results are the same as if all loads were combined and measured on one meter.

Self-Exciting Synchronous Motor

Synchronous Motor with Polyphase Type of Field Winding May Be Designed for Self-Starting—Author Shows How Characteristics of This Motor Are Improved by Automatically Increasing Excitation with Load—Suitable for Industrial Applications

By J. K. KOSTKO
Electrical Engineer, St. Louis, Mo.

IT IS generally admitted that the field of application of synchronous motors is limited mainly by their poor starting characteristics and the necessity of direct-current excitation. Much attention has been given to the design of the amortisseur windings of the salient-pole type, with a view of improving the starting performance, but in the opinion of the writer, the problem of satisfying the conflicting requirements of a high-resistance rotor for starting and a low-resistance rotor for pulling into synchronism can be most satisfactorily solved by the use of a non-salient-pole structure, with a field winding of the polyphase type, adapted to be connected to an external resistance at starting and to a source of direct current at synchronism (Danielson motor). Structurally the motor is similar to an induction motor with a wide air gap and requires only such mechanical parts as are standard in the manufacture of induction and direct-current motors. At constant excitation the synchronous performance of such a motor is somewhat inferior to the salient-pole type, because its armature reaction is higher, and a sufficiently high maximum torque can be obtained only by the use of a strong excitation, which lowers the efficiency and increases the heating at light loads. Much better results are obtained if the excitation, instead of being kept constant, is made to increase with the load.*

The field circuit is usually a three-phase star-connected winding, and the direct-current exciting voltage is applied between one slip ring and the other two connected together, so that one phase carries full exciting current and each of the other two one-half of it. In a motor of normal proportions it will always be found that even if this winding is designed for the maximum permissible voltage between slip rings at starting, the number of turns in series is so small that the direct-current exciting current is very large and the exciting voltage extremely low, requiring an exciter of somewhat abnormal proportions.

Exciter Is Wound on Revolving Armature

When the alternating-current supply voltage and the capacity of the motor permit of disposing the armature winding on the rotating member, a non-salient pole motor can be improved in many respects by constructing it as a self-exciting machine, deriving its excitation from a small direct-current type winding superposed on the main alternating-current winding and connected to a commutator. An automatic increase of the excitation with the load can then be obtained by the simple expedient of setting the brushes at a suitable angle with respect to the armature field, which is stationary relative to the field member. The necessity of disposing the armature winding on the revolving member limits the application of this arrangement to low-voltage, moderate-power motors, where the insulation of the revolving winding and the transmission of the line current by means of slip rings offer no difficulty. But when this construction is applicable it has still another advantage: a stationary field winding can be made reconnectable for different number of turns, so as to satisfy the condition of a low induced voltage at starting and a reasonably low exciting current during synchronous operation. However, even in this case the exciting armature winding must be proportioned for a comparatively low voltage, so that sparking is not likely to occur even if no special precautions are taken against the effect of short-circuiting armature coils in a magnetic field.

The field winding is designed for a very small slip, to facilitate the pulling into synchronism; the impedance of the exciting armature being very small relative to the field winding, it can be left in circuit during the starting period. The synchronizing is entirely automatic, without any rush of current or mechanical stress, because the excitation builds up gradually and, naturally, always with the "right" polarity. No difficulty need be anticipated from the absence of the "locking into synchronism" effect of the salient poles, this absence being more than compensated by the rapidity of building up of the field, due to the completely laminated magnetic circuit.

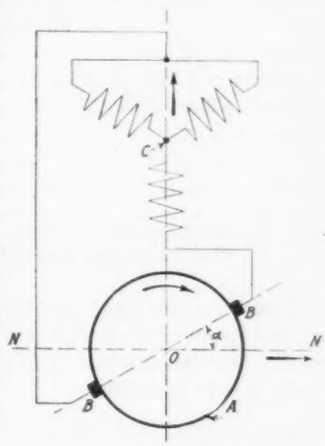


FIG. 1—ARRANGEMENT OF EXCITER AND FIELD WINDING

The object of this article is to study the synchronous performance of a non-salient pole, self-exciting motor, as influenced by the brush displacement and by the selection of the constants of the exciting circuit.

Fig. 1 shows the exciting circuit connected for the synchronous operation. It consists of the armature *A*, brushes *B* and field *C*, the latter shown as a three-phase star connected winding. For the sake of simplicity, the main alternating-current armature winding connected to the slip rings, and all auxiliary apparatus, resistances, etc., used at starting, are not shown in the figure. In what follows the saturation of iron will be considered as negligible, which is usually the case in a non-salient pole structure; but it will be shown how to find the limit beyond which the theory ceases to be applicable on account of the saturation.

The direct-current emf. induced in the exciting armature winding is proportional to the component of the flux normal to the line of brushes *BB;* the flux set up by the field winding *C* is proportional to this emf.; therefore, there is a constant ratio *a* between these two

*On the subject of non-salient-pole-type synchronous motors see Dr. Steinmetz, "Theory and Calculations of Electrical Apparatus," p. 57; C. J. Fechheimer, "Self-starting Synchronous Motors," *Transactions* A. I. E. E., 1912, Vol. 31, p. 529 (discussion); Dr. E. Rosenberg, "Self-synchronizing Machines," *Journal I. E. E.* (London), June, 1913.

fluxes. Neglecting the weak direct-current reaction of the exciting armature A, the action of the exciting circuit during the synchronous operation is fully determined by this constant a and by the angle $(BON) = \alpha$ between the line of brushes BB and the neutral axis NN.

The alternating-current armature flux can be considered as the resultant of a longitudinal flux F_e, coaxial with that produced by the exciting winding C and set up by the reactive component of the current (with respect to the back-emf. induced by the field of the exciting winding C), and a transversal flux F_t, directed along NN and due to the active component of the current. As various fluxes will figure in the same analytical expressions, it is convenient to select positive directions of their axes, for instance as shown by the arrows, and consider a flux as positive or negative, according as it acts in the positive or negative direction of its axis. With this convention the constant a will be positive in a self-exciting machine.

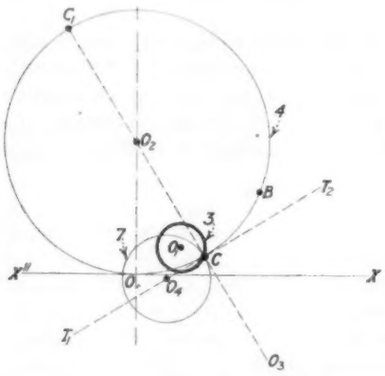


FIG. 2—DIAGRAM FOR DETERMINATION OF EXCITER BRUSH POSITION

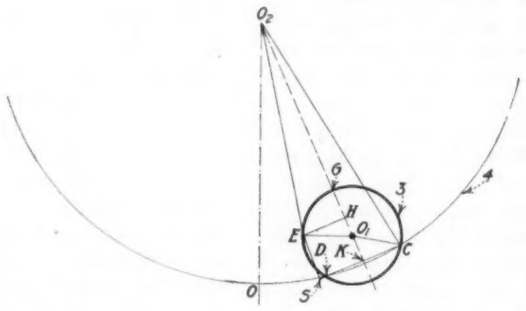


FIG. 3—DIAGRAM FOR INVESTIGATION OF TORQUE CHARACTERISTICS

Let F be the total longitudinal flux, equal to the algebraic sum of F_e and flux F_f set up by the field winding. The flux normal to the line of brushes is $F \cos \alpha - F_t \sin \alpha$; therefore:

$$F_f = \frac{F \cos \alpha - F_t \sin \alpha}{a} = \frac{(F_l + F_f) \cos \alpha - F_t \sin \alpha}{a}$$

This equation gives

$$F_f = \frac{F_l \cos \alpha - F_t \sin \alpha}{a - \cos \alpha}$$

If α is considered as positive or negative, according as the brushes are displaced against rotation or with rotation, all expressions hold good for any position of the brushes; but the case $\alpha < O$ is of no interest, because, in a motor, it corresponds to the weakening of the main field by the armature reaction; the condition $\alpha > \pi/2$ also need not be considered, because in this case the flux, which is set up by the exciting winding through the action of the flux F on the exciting armature is opposed to F; this will prevent the motor from falling into step. For all practical purposes it is sufficient to consider the case $O < \alpha < \pi/2$.

Let r be the resistance per phase of the main alternating-current winding, x = the leakage reactance, and X = the total synchronous reactance, *i.e.*, $X = x + 1/b$, where b is the exciting susceptance, which can be calculated as for an induction motor. The reactance of armature reaction is $X - x$; it should be made low by a suitable selection of the air gap, which can be made fairly wide without affecting the starting performance to any extent.

Fig. 4 is the vector diagram of the motor. OI' is the current I'; $OA' = rI'$, $A'B' = xI'$, $B'C' = (X - x)\ I'$. The emf. of armature reaction $B'C'$ is itself the sum of two components, E_t and E_l, at right angles to one another, due to the fluxes F_t and F_l respectively. Since the flux F_f is coaxial with F_l, the back-emf. due to F_f has in the diagram the same direction as E_l (although, of course, not necessarily the same sense), and the value E_f of this back-emf. is

$$E_f = E_l \times \frac{F_f}{F_l} = E_l \frac{1}{a - \cos \alpha} (\cos \alpha - \frac{F_t}{F_l} \sin \alpha).$$

But in Fig. 2, $F_t/F_l = E_t/E_l = \tan\omega$ and $E_l = B'C' \cos\omega = (X—x)\ I' \cos\omega$; therefore $E_f = (X—x)$

$$I' \cos\omega \times \frac{\cos a - \tan\omega \sin a}{a - \cos a} = \frac{(X - x)\ I'}{a - \cos a} \cos(\omega + a) \quad (1)$$

The vector $C'E' = E_f$ represents this emf. The applied voltage V' is then represented by the vector $E'O$.

If the machine is supplied with a constant current I', the points A', B' and C' are fixed, and the locus of point E' is a curve represented in polar co-ordinates by the equation (1), in which E_f is considered as the radius-vector and ω as the vectorial angle, with pole C' and polar axis $A'X'$. This equation is that of a circle 1 of radius $(X—x)\ I'/2\ (—\cos \alpha)$ having its center O' on the line $C'O'$, which makes an angle equal to α with $A'X'$. If $a > \cos \alpha$, the center is to the right of C' and above $A'X'$; if $a < \cos \alpha$, it is to the left of C' and above $A'X'$. C' is the short-circuit point, the back-emf., E_f, being zero at this point. The point D', in which this emf. $= C'D'$ is at right angles to the current, is the no-load point. Below $C'D'$ the machine delivers mechanical energy; above $C'D'$ it consumes it.

The vector $E'O$ represents the variable applied voltage V' corresponding to the constant current I'; at the given constant voltage V the current would be $I = I' \times (V/E'O)$. Let $E'O$ be produced to E'' selected so that $OE'' = I = I' \times (V/E'O)$. If the axis OY is considered as the direction of the applied voltage, the vector OE'' can represent the current I, except that it shows a lead when the current is lagging, and vice versa. To obtain the correct phase relation it is only necessary to replace OE'' by the vector OE, symmetrical to OE'' with respect to OY.

The relation $OE'' \times E'O = I'V$ shows that the point E'' is the inverse of the point E' with respect to the point O, the constant of inversion being $I' \times V$. The locus of E'' = the inverse of the locus of E'—*i.e.*, of the circle 1—is also a circle 2, and the true current locus at constant applied voltage is a circle 3, symmetrical to the circle 2.† The points D and C, corresponding to D' and C', are the no-load point and the short-circuit point respectively. Above CD the machine op-

†On the principle of inversion as applied to alternating-current problems see Arnold, *Wechselstromtechnik*, Vol. 1, second edition, p. 70.

erates as a motor; below CD it consumes mechanical energy and may act as a generator if the circle 3 has points below $X''X$.

It may be pointed out here that, for the sake of clearness, the diagram of Fig. 2 has been drawn so as to show the circles 1, 2 and 3 separate from each other, corresponding to an extremely poor, underexcited ($a > \cos \alpha$) motor. A good, strongly excited ($a < \cos \alpha$), leading-power-factor motor would have the center of its circle 1 above $X'X'$, with the origin O inside of it. The circles 1, 2, 3, would then overlap on one another, but all conclusions would be the same as for non-overlapping circles.

The study of the exciting circuit in its relation to the synchronous performance can now be more particularly defined as an investigation of the relations between the elements of the circle 3 and the constants a and α.

Values of a and α Giving a Desired Current Locus.—In this case the first step is to express the desired performance in the form of a current locus. The relation between various performance data and the circle 3 can be found as follows:

The points B', C' and D' lie on the line $X'X'$. Their inverse points lie on the inverse of $X'X'$, which is a circle 4, having its center O_2 on OY. Its diameter is $\frac{V \times I}{OA'} = \frac{V \times I}{rI} = \frac{V}{r}$, and the radius $OO_2 = \frac{V}{2r}$. When the constants a and α vary, the no-load point D'' moves on this circle, but the points B'' and C'' are fixed and determined by the relations

$$\tan X''OB' = \frac{OA'}{A'B'} = \frac{rI}{xI} = \frac{r}{x},$$

$$\tan X''OC' = \frac{OA'}{A'C'} = \frac{rI}{XI} = \frac{r}{X},$$

$$OB' = \frac{V \times I}{OB'} = \frac{V \times I}{zI} = \frac{V}{z},$$

$$OC' = \frac{V \times I}{OC'} = \frac{V \times I}{ZI} = \frac{V}{Z},$$

with $z = \sqrt{r^2 + x^2}$ and $Z = \sqrt{r^2 + X^2}$.

The triangle OO_2E gives: $OO_2^2 - O_2E^2 = 2 \times OO_2 \times OE \times \cos \varphi - OE^2$.

But $OO_2 = V/2r$; $OE = I$, therefore $OO_2^2 - O_2E^2 = (V \times I/r) \times \cos \varphi - I^2$; hence

$r\,(OO_2^2 - O_2E^2) = V \times I \cos \varphi - I^2r$ = input − ohmic loss = torque (per phase) in synchronous watts (including iron, friction and exciting losses) (2)

Since OO_2 is constant, this expression shows that the torque at a point E depends only on the distance O_2E of this point from the fixed point O_2; therefore, a circle concentric with the circle 4 is a locus of points of equal torque, *i.e.*, of equal power. By means of the expression (2) (with OO_2 and O_2E in amperes) the radius OO_2 can be graduated in terms of the torque, and the latter can then be determined at any point E by describing an arc of circle 5 passing through E. For a given current locus 3 the maximum torque corresponds to a circle 6 tangent to 3 at G. The maximum possible torque of the motor occurs when $O_2E = O$, and is equal to $r \times OO_2^2 = V^2/4r$, as in every synchronous motor.

The triangles $OC'E'$ and $OC''E''$ are similar because $OC' \times OC'' = V \times I' = OE' \times OE''$, *i.e.*, $OC'/OE' = OE''/OC''$, and $\angle C'OE' = \angle C''OE''$; therefore $C'E'/C''E'' = OC'/OE'' = ZI'/I$. Let E_f be, in the constant potential (c.p.) operation, the back-emf. due to F_f; in the constant current (c.c.) diagram it is represented by $C'E'$; therefore

$$E_f = C'E' \times (I/I') = C''E'' \times (ZI'/I) \times (I/I') = C''E'' \times Z = CE \times Z, \quad (3)$$

which shows that the segment CE, expressed in amperes and multiplied by Z, gives the back-emf. E_f. This emf, in turn gives the flux F_f, because the alternating-current armature winding is known. Since, for a given structure, the distribution and the weight of copper of the exciting winding may also be assumed as known, the ohmic loss in the exciting circuit is determined by the value of F_f and is proportional to the square of it. Thus, in the diagram, the exciting current loss is proportional to the square of the segment CE.

Let E_r be, in the c.p. operation, the emf. generated by the total flux common to the stator and the rotor, *i.e.*, by the resultant of F and F_f. In the c.c. diagram this emf. is represented by the vector $B'E'$. By the same reasoning as above the emf. E_r can be determined from the similar triangles $OB'E'$ and $OB''E''$, and is found to be

$$E_r = BE \times z. \quad (4)$$

From the emf. E_r and the armature winding data the resultant common flux can be calculated. This flux is the measure of the iron losses and, which is perhaps more important, of the degree of saturation of the magnetic circuit. Let E_{rs} be the value of E_r corresponding to the flux at which the iron begins to become saturated. A circle described with center B and radius E_{rs}/z will contain all points of current loci to which the theory is applicable. For points outside of this circle it is only roughly approximate.

Thus, at any point E, the input, the torque, the power-factor $\cos \varphi$, and all the losses can be determined; and any performance, compatible with the fundamental characteristics of this type of motors can be expressed in the form of a circular-current locus passing through the point C. It remains only to find the values of the constants a and α which correspond to a given locus.

The circle 1 and the line $A'X'$ cut at C' at an angle equal to the angle of their normals $N'C'O' = \pi/2 - \alpha$. It is well known that the normals to the inverse curves 2 (3) and 4 make the same angle with each other at the corresponding point C'' (C); if O_1 is the center of the desired locus, then

$$\angle O_1CO_2 = \frac{\pi}{2} - \alpha \quad (5)$$

Let E_{fo} and E_{ro} be the values of the emfs. E_f and E_r at n load, *i.e.*, for $\omega = O$. Fig. 2 gives: $E_{fo} = C'D' = \frac{X - x}{a - \cos \alpha} I' \cos \alpha$; $E_{ro} = B'D' = B'C' + C'D' = (X - x)I' + \frac{X - x}{a - \cos \alpha} I' \cos \alpha = \frac{X - x}{a - \cos \alpha} \times aI'$; therefore $\frac{E_{ro}}{E_{fo}} = \frac{a}{\cos \alpha}$. But $E_{ro} = BD \times z$; $E_{fo} = CD \times Z$, therefore $\frac{a}{\cos \alpha} = \frac{z}{Z} \times \frac{BD}{CD}$. Let R be the radius of the locus 3 and d = the distance of its center O_1 from the fixed line O_2C; then $\sin \left(\frac{\pi}{2} - \alpha\right) = \cos \alpha = \sin O_1CO_2 = d/R$, and

$$a = \frac{z}{Z} \times \frac{d}{R} \times \frac{BD}{CD}. \quad (6)$$

By means of the expressions (5) and (6) the constants a and α can be determined from the drawing of the specified current locus.

When a varies from O to $\cos \alpha$, $C'D' = \frac{X - x}{a - \cos \alpha} I' \cos \alpha$ varies from $-(X - x)I' = C'B'$ to $-\infty$. When

a varies from cos α to $+\infty$, $C'D'$ varies from $+\alpha$ to O. In other words, with the adopted limits for a and $\alpha(a>O,\ (\pi/2)>\alpha>O)$, the no-load point D' can occupy any position on $X'X'$ with the exception of the segment $B'C'$. In the c.p. diagram the point D may fall on any point of the circle 4 except the (shorter) arc CB.

The useful range of the values of α being O to $\pi/2$, the relation (5) shows that the center of the current locus must fall within the angles T_1CO_2 or T_2CO_2 (Fig. 2) which the tangent T_1T_2 to the circle 4 makes with the normal O_2O_1. Let C_1 be the point of the circle 4 diametrically opposite to C; if D falls on the shorter arc BC_1, the perpendicular bisector of the segment CD obviously has points within both angles T_1CO_2 and T_2CO_2, and the centers of the loci passing through D can lie within either of these angles. If D lies on the arc COC_1, the perpendicular bisector of CD has

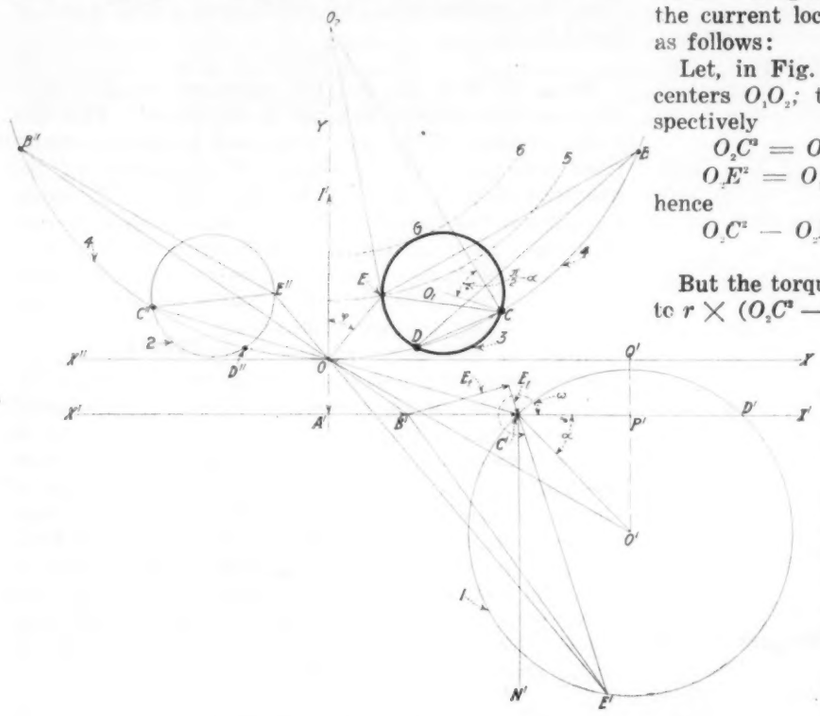


FIG. 4—PERFORMANCE DIAGRAM OF SELF-EXCITED MOTOR

no points in T_2CO_2, and the center of the current locus must be in the angle T_1CO_2. With normal proportions of the circle 4 the case of the no-load point D on the arc BC_1 is of no practical importance, and it may be stated quite generally that (subject to the check of the saturation, as described above) constants a and α, comprised within their useful range, exist for any desired current locus passing through the point C and having its center within the angle T_1CO_2 and its no-load point on the arc COC_1.

The performance of the motor with the brushes on the neutral ($\alpha = O$) is represented by a circle 7 having its center O_4 on the tangent CT_1. The excitation, which is proportional to CE, decreases rapidly with the load, and, unless the exciting current is made excessively strong at no-load, the power factor is poor and the overload capacity low, which explains why such motors have met with very little success in the past.

The inverse problem of constructing the current locus corresponding to given values of a and α can be solved by considering the center O_1 as the intersection of the line CO_1, Fig. 4, determined by the value of α, with the radius vector OO_1 (not shown in the figure), inclined to $X''X$ at the same angle as the radius vector OO' This angle is determined by the relation

$$\tan O_1OX = \tan O'OX = \frac{O'Q'}{OQ'} = \frac{O'P + PQ'}{A'C + CP} =$$

$$\left[\frac{X-x}{2(a-\cos\alpha)} I \sin\alpha + rI\right] \div \left[XI + \frac{X-x}{2(a-\cos\alpha)} I\cos\alpha\right] =$$

$$\frac{(X-x)\sin\alpha + 2r(a-\cos\alpha)}{2aX - (X+x)\cos\alpha}.$$

The comparative study of the torque conditions of various current loci can be made by means of circles 5; but in a given locus it is easier to follow the variation of the torque by considering it as represented by the distance ES (Fig. 3) of the point E from the line joining the no-load and the short-circuit points. This is the general property of c.p. diagrams in which the current locus is a circle. It can be demonstrated as follows:

Let, in Fig. 4, EH be perpendicular to the line of centers O_1O_2; the triangles O_1CO_2 and O_1EO_2 give respectively

$$O_2C^2 = O_1O_2^2 + O_1C^2 + 2 \times O_1O_2 \times O_1K,$$
$$O_2E^2 = O_1O_2^2 + O_1E^2 - 2 \times O_1O_2 \times O_1H;$$

hence

$$O_2C^2 - O_2E^2 = 2 \times O_1O_2 \times (O_1K + O_1H)$$
$$= 2 \times O_1O_2 \times ES.$$

But the torque has been previously found to be equal to $r \times (O_2C^2 - O_2E^2)$; therefore

Torque in synchronous watts $= 2r \times O_1O_2 \times ES$, where $2r \times O_1O_2$ is constant for a given current locus. The operation is stable between D and G, and unstable between G and C.

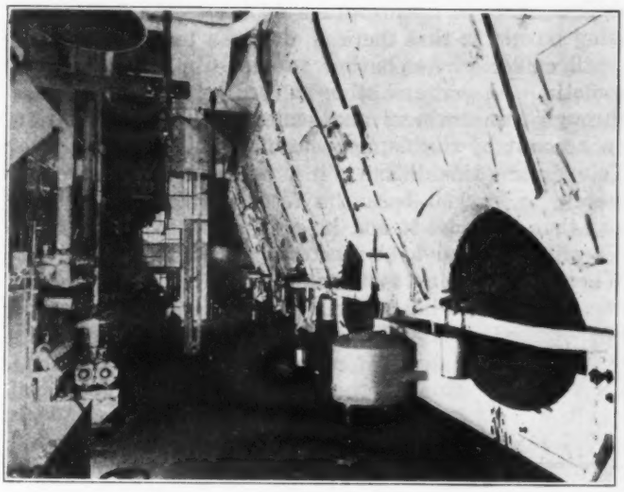
It is interesting to note that the current locus is the case of the constant separate excitation—*i.e.*, constant back-emf. E_f, can be represented in the diagram of Fig. 4 by a circle described from C as a center with E_f/Z as a radius, all other elements of the diagram, such as constant torque circles 5, the line BE representing the resultant emf. E_r, etc., having the same meaning as for a self-exciting motor. This can be seen by reference to Blondel's bipolar diagram, or it may be considered as following directly from the relation (3), which, as well as relation (4) and the properties of circles 5, has been established generally for any point E, without reference to the locus to which it belongs. This relation shows that if E_f is constant the point E describes a circle having C for the center. The self-exciting motor, in which not only the radius but also the center of the current locus can be selected at will, has the advantage of a greater flexibility, but the performance of one type cannot be reproduced by the other, the point C being a point of the locus in one case, and its center in the other.

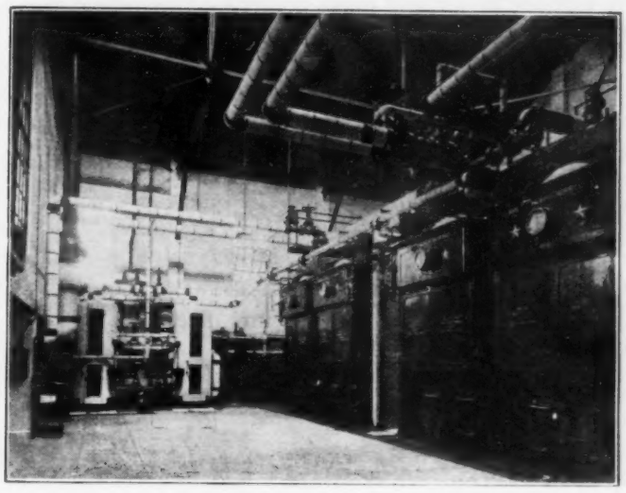
"IT IS *the duty of the government to do business honestly and intelligently, to elevate and not to degrade the standards of business integrity, and to make it easy for business men to know whether they are complying with specifications, and to assist them where they need help most. In other words, it is the duty of the government to make it easy to do right in business and hard to do wrong.*"—Dr. E. B. ROSA.

Burning Oil with Mechanical Atomizers

May Eventually Be as Extensively Used in Stationary Plants as Steam Atomizer — Best Operating Pressures and Temperatures, Some Advantages and Disadvantages

By ROBERT SIBLEY and C. H. DELANY





OIL-FIRED BOILERS EQUIPPED WITH MECHANICAL ATOMIZERS

At left, fire-room arrangement showing Bethlehem oil-burning system using a mechanical atomizer, installed on a 12,000-ton freighter fitted with Howden forced draft. This type of mechanical atomizer is already installed aboard vessels aggregating over 2,500,000 i.hp. At right, a typical installation for mechanical atomization on land. The view shown is that of the San Francisco Hospital, in which four 250-hp. water-tube boilers are equipped to burn either coal or oil.

WHILE steam atomizing oil burners are used almost exclusively in stationary power-plant work at the present time, the mechanical atomizing oil burner has found great favor in marine work and is the standard method of firing oil-burning marine boilers at the present time. Much interest is shown concerning the use of the mechanical atomizing burner in stationary plants, and it is possible that it may eventually be as extensively used in this field as the steam atomizing burner or may entirely displace it.

The mechanical atomizing burner, sometimes called a pressure-jet burner, is made in a number of different forms all of which operate on the same principle. It consists essentially of a nozzle containing a small conical orifice through which the oil is forced at high pressure, the oil being first heated to a temperature approaching its flash point. Inside the nozzle means are provided to give the oil a whirling motion of sufficient intensity to make it fly into a spray on account of the centrifugal force as soon as it leaves the nozzle. The burners are placed in the boiler front, and each burner is provided with an air-regulating device which admits the air around the burner, at the same time regulating the quantity of air to suit the combustion requirements. In some makes of mechanical burners the air receives a twisting motion as well as the oil, which adds to the effectiveness of the mixing of air and oil for combustion. Where the boilers are to be operated at high capacities the air is supplied by means of forced draft.

The operation of these burners varies with both the pressure and temperature of the oil. The pressure must be at least 60 lb. (4.2 kg.) in order to produce good atomization, and it may be increased up to 200 lb. (14 kg.) Pressures higher than 200 lb. are not required and only cause unnecessary stress of the oil piping. The quantity of oil being burned is regulated by varying the pressure from 60 lb. up to 200 lb. If more oil is required than can be obtained at the higher pressure, it is necessary to change the nozzles, using tips with larger orifices. If less oil is needed than passes through the burners at 60 lb. pressure, it is necessary to shut off some of the burners.

A temperature of at least 150 deg. F. (66 deg. C.) is required to atomize the oil properly. The atomization is improved by increasing the temperature up to about 200 deg. Above this temperature no change is made in the atomization but the flame becomes shorter and the combustion occurs closer to the burner as the oil is heated to a higher temperature. As the oil is heated the first effect is to reduce its viscosity resulting in a greater quantity of oil passing through the burner. At the higher temperatures, however, the increased temperature has little effect on the viscosity but owing to the increased volume of the oil the capacity of the burner is reduced.

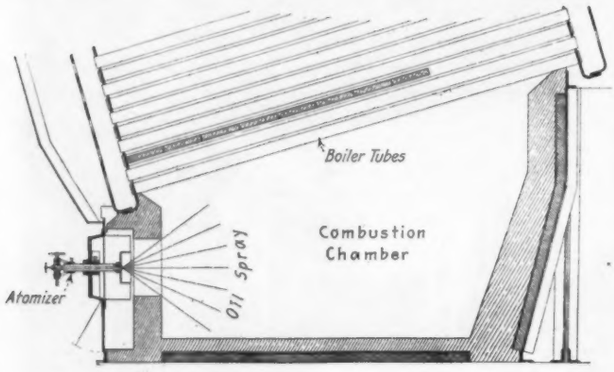
The following table gives the quantity of oil that will flow through a burner having a $\frac{1}{16}$-in. (1.6-mm.) diameter orifice at a pressure of 200 lb. (14 kg.), the oil having a gravity of 20 deg. Bé. and a flash point of 220 deg. F. (105 deg. C.):

Temperature (deg. Fahr.)	Pounds Oil Per Hour	Remarks
60	340	No atomization.
110	440	Bad sparking.
153	375	Atomization good.
210	330	Flame white and short.
260	300	Flame shorter.
304	273	Flame 2 ft. long.

The principal advantage of the mechanical atomizing system is that a large quantity of oil can be burned in a furnace of a given volume.

The steam atomizing burner as applied to stationary boilers produces a flat flame and the combustion occurs on the upper and lower surfaces of this flame, with the result that a considerable proportion of the volume of the furnace is not made use of.

With the mechanical atomizing burner, on the other hand, there is what may be called volume combustion, the mixture of air and gases occurring throughout the entire furnace. It is, therefore, possible to completely

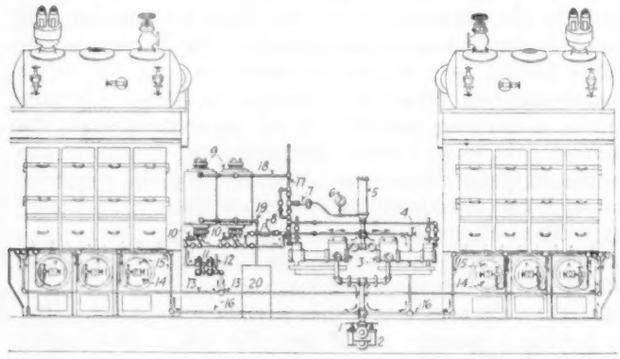


OIL-BURNING FRONT FOR WATER-TUBE BOILERS, SHOWING CONICAL-SHAPED FLAME OBTAINED WITH MECHANICAL ATOMIZATION

burn more oil in a given size of furnace by this method than by the steam atomizing method, or if the same quantity of oil is burned in both cases the combustion with the mechanical atomizing system will be more complete in the furnace proper, so that the flame will not travel so far among the boiler tubes and the entire efficiency of the boiler will be greater.

The cooling of the gases by their contact with the boiler tubes before the combustion is completed is one of the principal causes of low efficiency in boilers that are forced up to high capacities, and any method of combustion that prevents this tends to improve the efficiency of the boiler.

The mechanical atomizing system also saves the steam that is used in the steam atomizing system,



ARRANGEMENT OF MOORE SHIPBUILDING COMPANY'S OIL-BURNING SYSTEM FOR WATER-TUBE BOILERS, SHOWING TYPICAL LAYOUT AND ACCESSORIES INVOLVED IN MECHANICAL ATOMIZATION

which often amounts to 3 per cent or 4 per cent of the total steam generated. While some steam is required in the mechanical system for heating the oil up to the higher temperature and for pumping it to the higher pressure, the condensation or exhaust from this steam returns to the feed-water heater so that the quantity utilized is not great. The loss of the steam used by the steam atomizing burner is of much greater importance for marine boilers than for stationary boilers, because it means a loss of fresh water as well as a loss of steam. It is for this reason that mechanical atomizing burners have already largely displaced steam atomizing burners on board ship.

The principal disadvantage of the mechanical atomizing burner is that there is always a tendency for the small orifice in the burner to choke up. This is due sometimes to grit and other solids in the oil which pass through the strainers and sometimes to carbonization on account of the flame occurring close to the nozzle. To overcome this difficulty it is necessary in some cases merely to slacken back the feed screw of the burner and then readjust it and in some cases to turn off the oil altogether and blow steam through the burner. Whenever the fire is burning one-sided sparking on one side or showing black streaks it is a sign that the burner needs cleaning. As the number of burners required for mechanical atomization is much greater than for steam atomization, this difficulty means a good deal of careful attention on the part of the operator. With steam atomizing three burners are sufficient to operate a large 800-hp. boiler, whereas a boiler of the same size would require ten or twelve mechanical atomizing burners.

Another objection to mechanical atomizing burners for stationary power-plant work is the fact that the air supply for each burner must be adjusted separately every time there is a change in the quantity of oil burned. This is not objectionable where there is a steady load, as on board ship, but in a stationary power plant where the load is changing continuously a continual adjustment of the air supply would mean constant attention on the part of the fireman.

Notwithstanding these objections, it seems probable that the mechanical atomizing system will be introduced to some extent in stationary work, especially where it is essential to operate the boilers to very high capacities.

Prompt Payment Discount Eliminated

INSTEAD of giving its customers a discount for paying their bills promptly, the Springfield (Mo.) Gas & Electric Company tells them that they become delinquent if the bill is not paid within ten days. This policy, which was inaugurated about a year ago, has proved profitable to the company and appears to be satisfactory to its customers. The company has saved the discount and reduced the amount of its bad debts.

No prompt-payment discount was given during the greater part of 1919, and in that year the bad debts which had to be written off the company's books amounted to 0.44 per cent of the gross revenue. This was less than half the loss sustained in the best year in which a discount was allowed. In 1916 the bad debts amounted to 1.5 per cent, in 1917 to 1.81 per cent, and in 1918 to 1.03 per cent. A discount was allowed during each of these three years.

The change was made at a time when the people had plenty of money, and now the new system is so firmly established that no future difficulties are anticipated. If a customer does not pay his bill a notice is sent out at the end of fifteen days. If necessary, two other notices are sent at intervals of two or three days, after which the service is cut off.

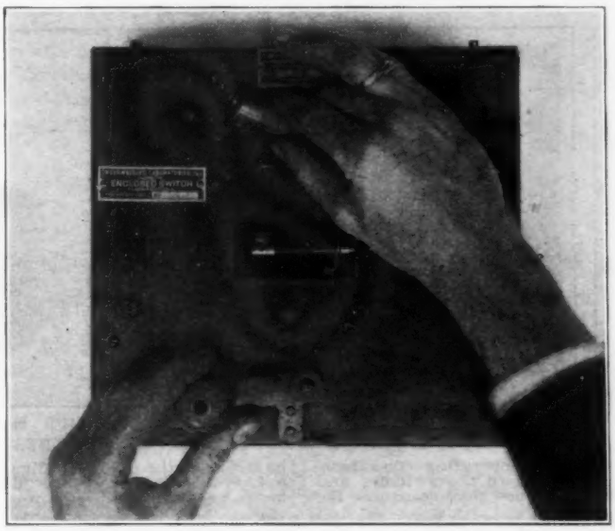
Protect Workmen by Inclosing Switches

Records Show That Exposed Switches Have Been Responsible for Many Accidents—Features of Typical Inclosed Switches Discussed—Rules Regulating Use of Switches Show Wide Variation

By A. WALDSCHMIDT
Assistant Physicist Bureau of Standards

RECORDS show that exposed parts of switches have been responsible for many accidents. The reasons are clear since the greatest number of exposed parts are to be found at switches, and switches are handled more by the unqualified employees than any other type of apparatus having unprotected parts. There are also to be considered fuses and fuse terminals, usually found combined with switches, but sometimes separated therefrom, which are frequently handled by unqualified persons in renewing blown fuses.

Some far-seeing managers of industrial plants who believe in efficiency, maximum production and the welfare of employees provided the necessary safeguards for their equipment long before any mandatory rules required safeguarding. Manufacturers of safety inclosed switches are to be commended for their efforts in developing safety switches to meet the increasing demand and varying conditions of service.



WITH HIGH-PRICED LABOR PROTECTION HAS BECOME A SOUND ECONOMIC POLICY

The conditions under which switches and fuses are used have suggested three types of persons to be protected. First there is the ordinary worker, second the authorized operator, and third the qualified attendant. Conditions under which switches are installed vary greatly, and the type of protection to provide depends largely on these conditions. In a small industrial plant the authorized and qualified workers may be predominant in numbers, while in many occupations the ordinary worker may predominate. It is therefore clear that service conditions should dictate what type of protection is proper.

The ordinary worker has to be protected from contact with live parts in passing by a switch. He must also be protected against short-circuiting the switch with metal bars or pipes which he may be carrying. This may be accomplished by the ordinary inclosure without necessarily employing the externally operable feature. The cabinets must be kept locked to exclude the ordinary worker. Where such employees are expected to operate switches at times and also to renew fuses one of the higher degrees of protection is necessary.

For the authorized operator protection should be provided against contact with live parts during ordinary operation of the switch and also against contact with live parts in renewing fuses. Both external operation and automatic disconnection of fuses should be provided in this case. Qualified operators are supposed to be familiar with the hazards involved and with the construction and operation of the apparatus, so that a less degree of protection is necessary. Frequently all three classes of workers are involved in operating one installation, in which case the higher degrees of protection are desirable.

The knife switch remained unprotected until the absolute necessity for protection created a demand on the manufacturer for the development of different types to meet various conditions of service. There are at present available several distinct types of inclosed switches embodying different degrees of protection. The first but most meager type of protection is that characterizing the ordinary knife switch, either fused or unfused, inclosed in an iron or steel cabinet. Protection against short circuits and fire caused by accidental contact with conducting materials handled in the vicinity is afforded by this type of inclosure. The operator, however, is not protected against shock or burns due to coming in contact with live parts of the switch and the grounded metal of the cabinet. The presence of live parts of an ordinary knife switch in a grounded metal cabinet is a greater hazard as regards shock than inheres in those parts not inclosed in a metal cabinet.

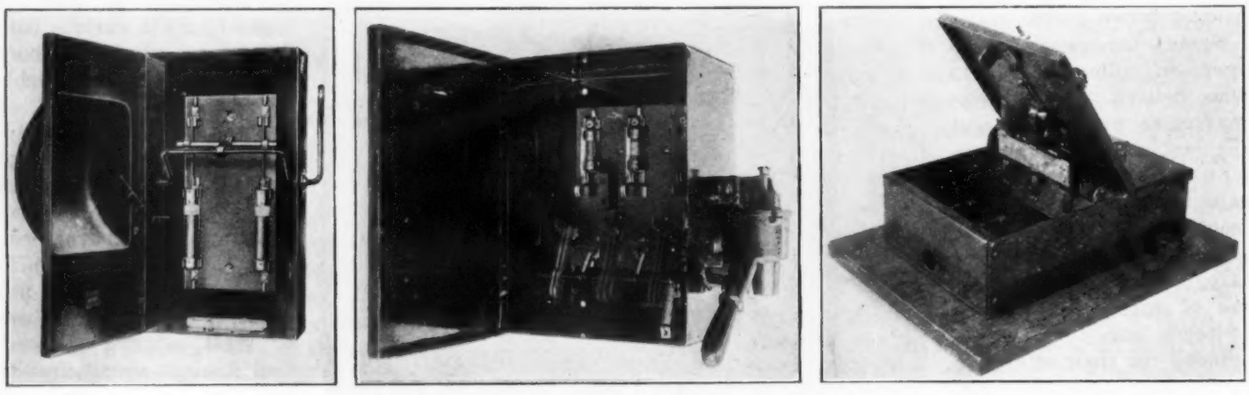
The second type of protected knife switch may be referred to as the externally operated type. It is inclosed in an iron or steel cabinet having a handle on the outside of the case by which the switch may be operated without opening the case. This kind of switch is not only protected against accidental short circuits caused by bars of metal and similar material handled in the vicinity but it also protects the operator from contact with live parts. A commendable degree of protection is afforded by this type, especially where kept locked so as to exclude ordinary workers.

A third type is also externally operated but is combined with fuses and provided with an interlocking arrangement which does not permit opening the door of the inclosure when the switch is in the "on" position or closing the switch when its door is open. If properly connected so that the fuses are dead when the switch is in the "off" position a certain degree of protection is afforded to the person renewing fuses. But in this type of fused switch there are some parts alive with which the person may accidentally come in con-

tact. The probability of this is, however, somewhat remote, though the switch is not absolutely foolproof.

The fourth type of switch affords a greater degree of safety than the previous one, and it is always fused. It is capable of external operation and is so interlocked that fuses are dead before they can be handled, and, moreover, there are absolutely no live parts exposed to the operator or the person renewing fuses. It is more nearly foolproof than the previous types and more desirable in places where fuse renewals are made by the ordinary or unqualified employee.

In all of the above-mentioned switches wrong connections are possible. If the wireman does not connect the switch properly, the fuses will be alive at all times and therefore the most important element of safety—namely, safety to persons renewing fuses—is lost. A fifth type which may be mentioned is really foolproof. It is capable of external operation and is so interlocked that fuses are dead before they can be handled, and



TYPICAL EXAMPLE OF DEVELOPMENTS IN SAFETY SWITCHES

The selection of a type is dependent on operating conditions. Where only qualified operators have access to the switches and fuses very little protection is required because they recognize the hazard. In the case of ordinary workers changing fuses, however, a type in which fuses are "dead" and no live parts exposed is a desirable feature.

there are no live parts exposed to the operator or the person renewing fuses; nor can it be wrongly connected as can the previous types so that some parts will be alive.

Some administrative and inspection authorities have advocated rules requiring the inclosure of live parts of switches and cut-outs. However, a consideration of these rules has indicated a lack of uniformity. It would seem that uniform rules could be formulated that would be equally applicable in all States and municipalities. A review of several of these existing rules, compared with the equivalent rules contained in the National Electrical Safety Code promulgated by the Bureau of Standards, might suggest improvements in the matter of uniformity. Below is indicated the substance of these rules as advanced by various administrative or inspection departments in what might be termed representative territories:

City of Detroit.—All knife switches except on approved switchboards under constant supervision of a competent electrican must be approved safety inclosed type designed to be operated from the outside of the inclosure and can be locked in the open position.

Safety inclosed switches must be so marked as to indicate without opening the inclosure whether switches are closed or open.

All distribution panels with switches must be approved safety design so constructed and installed that no live metal will be exposed and that the fuses, if fuses are used, will not be alive when switches are open; except in double-throw switches for alternating-current motor starting and running, switches must be so constructed and installed that the blades will not be alive when in the open position.

City of Chicago (in effect Jan. 1, 1920).—Knife switches, except on panelboards and switchboards, must be of the safety inclosed type. Safety inclosed switches must be of an approved design and arranged to be operated from the outside of the inclosure. They shall be so marked as to indicate without opening the inclosure whether the switch is in the "on" or "off" position. They shall be so constructed that fuses, if used, will be dead when the switch is open; and except in the case of double-throw switches and alternating-current motor starting switches designed for running and starting positions, they must be so constructed and installed that the blades of switch will be dead when the switch is in the open position. If in order to comply with the above the incoming wires must be connected to certain terminals, such terminals must be marked "line."

California Industrial Accident Commission.—All manual switches shall have suitable casings or guards protecting the operator from danger of contact with current-carrying parts, effective during ordinary operation, except for switches or circuits not exceeding 150 volts to ground which are not located in permanently damp places or where local conditions entail a particular hazard.

Pennsylvania Department of Labor and Industry.—Exactly the same as the National Electrical Safety Code to be discussed below.

Wisconsin Industrial Accident Commission.—Recommends same provisions as National Electrical Safety Code.

Hydro-Electric Power Commission, Ontario.—All live parts of service equipment, including cut-outs, switches and meters, must be so protected that accidental contact therewith will be effectually prevented.

Great Britain, Home Office Regulations for Factories and Workshops.—Every switch, switch fuse, circuit breaker, and isolating link shall be: (a) so constructed, placed or protected as to prevent danger; (b) so constructed and adjusted as accurately to make and maintain good contact; (c) provided with an efficient handle or other means of working, insulated from the system, and so arranged that the hand cannot inadvertently touch live metal; (d) so constructed or arranged that it cannot accidentally fall or move into contact when left out of contact.

The problem of guarding current-carrying parts presents itself in two aspects, and any proposed rulings should be considered from this point of view. In the first place, persons are to be protected during the operation of turning switches on and off; in the second place, they are to be protected during the act of removing fuses. In other words, in the first case switches only are involved, and in the second combined switches and fuses. The National Electrical Safety Code covers the subject in the following quoted rules:

327a.—All manual switches, except switches under 150

volts to ground and limited by cut-outs to 60 amp., shall have suitable casings or guards protecting the operator from danger of contact with current-carrying parts, or shall be provided with insulating handles and suitable insulating guard disks or shields so arranged between the handles and live parts as to prevent the hand from slipping into contact with live parts or being burned by arcing at the switches.

b.—Current carrying parts of switches or automatic cut-outs operating at over 150 volts to ground shall be provided with inclosing guards, effective during ordinary operation if accessible to other than properly qualified persons.

c.—Where switches or cut-outs above 150 volts to ground are not guarded during ordinary operation suitable insulating floor mats or platforms shall be provided on which the operator must stand while operating the switches or adjusting automatic cut-outs, and (unless operators invariably wear suitable insulating gloves while handling the switches) any conducting walls or machine frames within 3.5 ft. shall be provided with suitable insulating guards.

d.—Switches shall, if practicable, be so connected as to have no live blades exposed to contact when a switch is open.

324a.—Fusible cut-outs in circuits operating at over 150 volts to ground shall, if practicable, where accessible to others than qualified electrical attendants, be so arranged that the ungrounded current-carrying parts cannot be touched by persons re-fusing the cut-out until such parts are disconnected from all sources of electrical energy. Where the circuit voltage exceeds 300 to ground, this arrangement shall always be made. It is recommended that this protection also be provided for fusible cut-outs operating below 150 volts to ground.

An analysis of the above Safety Code rules would indicate that the open switch, while ordinarily undesirable, is still permissible on circuits up to 150 volts to ground; but whenever the switches are fused above 60 amp., guard disks or other shields should be provided to protect the operator from burns and from contact with live parts. On voltages above 150 to ground it has been found proper to provide externally operable switches where otherwise accessible to ordinary persons.

When, however, switches above 150 volts are accessible only to a qualified attendant and others are excluded, they need not be externally operable but may be placed in ordinary locked cabinets. But at the same time any conducting floors should be provided with insulating platforms or mats. In general it is to be noted that the Safety Code rules permit of alternatives, recognize different degrees of hazard, and also differentiate between operating the switch and renewing fuses, both of which have some hazards in common, but for which different types of protection are required.

There is a strong sentiment in favor of including in the National Electrical (Fire) Code a rule requiring that in all future installations service switches be of externally operated type. The desirability of also including a similar rule to cover other types of control switches has been indicated.

Many industrial plants have installed at least some one of the five types of protection mentioned. Where 110 volts is used as the distribution voltage, the first type of protection—namely, mere inclosure of the ordinary knife switch in a metal cabinet—is provided in many industrial plants. While this type of protection prevents accidental contact by passers-by and short circuits from bars of metal handled in the vicinity, it does not protect the operator from shock and possible burns. However, the danger from shock on the lower voltages is not extremely great. But where voltages such as 220 or 440 are concerned the mere inclosure of knife switches in grounded metal cabinets is an extreme hazard that should not go unchallenged. The second type of protection—namely, an externally operated switch—offers a commendable degree of protection where the doors of the cabinets are kept locked to exclude unauthorized or unqualified persons. Locking of doors so as to exclude certain persons from replacing fuses or tampering with the switches has worked out well in actual practice. The third and fourth degrees of protection are provided in many industrial plants, even on the lower voltages, and these permit of the fuses being renewed by an ordinary employee as all current-carrying parts are dead when handled by such persons. Many electric service companies are providing service switches embodying this fourth type of protection. It not only protects their customers from shock and therefore the company from litigation, but it also prevents the theft of energy and therefore a loss of revenue to the company. In some of the larger cities of this country each and every service switch and fuse is of such type.

There are other minor safety features which are sometimes included in the inclosed switches now available. Many are provided with quick-break mechanism, thus preventing arcing, and this is specially desirable where the switch cannot be inspected in the closed position. Another safety feature is the providing of a grounding lug on the metal inclosures. This encourages grounding of the cases, which is particularly desirable where the switches are used on circuits above 150 volts to ground. Locking arrangements are also desirable and necessary and are usually provided by the manufacturer. The marking of the "on" and "off" positions is important and is almost always provided. For motor-starting switches no-voltage trips are sometimes embodied in the switches.

Estimated Cost of 2,500-Kw. Hydro-Electric Development

A TOTAL cost of $181 per kilowatt was estimated for a New England hydro-electric plant now under construction having two 1,250-kw., 13,200-volt, three-phase, 60-cycle generators directly connected to two 1,500-hp. water wheels. The design includes provision in the building for a third similar unit to be installed later. The dam consists of a concrete core wall and earth fill, with concrete spillway and headworks, water being taken to the power house through a 78-in. (198-cm.) wood-stave pipe line about 8,000 ft. (2.4 km.) long. The approximate head on the wheels is 175 ft. (53.5 m.) In building the plant the size of generating unit was slightly modified and the plant location was changed by a few hundred feet on account of reservoir location difficulties, but the itemized estimate for the original design shown herewith is indicative of the present costs.

ESTIMATED COST OF DEVELOPING 2,500-KW. HYDRO-ELECTRIC SITE

Dam, headgates, racks, etc.	$127,500
Penstock, 78-in. wooden	120,000
Power-station building and fixtures (brick and concrete)	30,000
Waterwheels with governors and relief valves	36,000
Generators and exciters	24,000
Switchboard and wiring	9,000
Transformers	10,000
Transmission line connections	1,000
Total	$357,500
Contingencies, 10 per cent	35,750
Total structural cost	$393,250
Interest during construction, organization, legal expenses, taxes and insurance during construction; 15 per cent	59,987
Total ($181 per kw.)	$453,257

Readers' Views and Comments

Field Testing of Instrument Transformers

To the Editor of the ELECTRICAL WORLD:

SIR: In the first part of the article on "Field Testing of Instrument Transformers," which appeared in the ELECTRICAL WORLD for Feb. 7, I described a method of calibrating standard current transformers and referred to it as new. At the time of publication I believed it to have originated at the standards laboratory of the University of Wisconsin in August, 1917, but within the last week my attention has been called to a previous publication. As a result I wish to make a correction.

In 1916 Otto A. Knopp proposed substantially this same method. His method is the same in that the current transformer ratio is reduced to unity and two watt-hour meters are used to compare primary and secondary currents. It differs in that he suggests the use of two service watt-hour meters in which the speeds have been specially adjusted and which have been provided with a mirror system for counting revolutions, instead of the more usual Agnew arrangement in which two standard watt-hour meters are used. Mr. Knopp's proposal appeared in the ELECTRICAL WORLD, Vol. 67, page 92 (1916), and in the *N. E. L. A. Bulletin* for November, 1916.

Madison, Wis. H. M. CROTHERS.

State Lines and Power Supply

To the Editor of the ELECTRICAL WORLD:

SIR: There is no economic reason why the mere existence of a state boundary line should limit the supply of energy in either direction. The policy of non-exportation may be as great a mistake as sweeping inhibitions upon bringing energy into a state by an independent system. There is little doubt, for instance, that without permitting power exportation the State of Vermont would be unable to secure its present energy supply at anything like the present figures. Through the sale of energy generated locally for distant markets, standards of production and distribution have become established which make for minimum power cost within the localities in Vermont in electrical touch with the exporting plant. It would be well for the people of Maine to ponder this.

The Connecticut case outlined in the March 6 issue of the ELECTRICAL WORLD, page 568, whereby an industrial concern was denied permission by the commission to build a transmission line to the state border for power importation will probably be appealed. The decision reinforces the right of a local company (the central station covering the district) to retain its hold upon the field, and so long as community power requirements are properly met by an established company there is much to be said on its side. If, however, a local central station, as in the celebrated Fitchburg and Worcester cases against the New England Power Company before the Massachusetts commission, is not at a given time ready to undertake to supply so-called large power customers, either directly or through purchase and resale of energy from outside, the situation becomes, or may become, acute. It is of the utmost importance that a suitable working arrangement be entered into if possible, with profit to all the utilities concerned. The mere existence of the state line, as was stated above, should have no significance in the ultimate satisfactory supply of energy to a territory at the lowest cost to its residents and business establishments consistent with a fair return upon the total expense of supply. It may be pointed out also that the immediate clarification of local resources is of pressing importance with hydro-electric energy knocking at the northern door of the state.

Boston, Mass. H. S. CLARK.

Position of the Small Manufacturer

To the Editor of the ELECTRICAL WORLD:

SIR: I have read the interesting article in the ELECTRICAL WORLD for March 13, page 630, on the unequal price level. I agree with you in your views regarding the situation except that I have my doubts about the wholesale cancellations. As long as the demand continues the stress of business will continue, and the demand will continue as long as the working people keep buying.

The workers, especially the skilled workers, are making more money than they ever have made, and they are spending it. You will notice them buying silk shirts, high-priced shoes, pianos, victrolas. Their wives and daughters are wearing furs and expensive hats and so on. Until the skilled worker reaches the point where he has had enough of luxury the demand will continue, and, as you know, this demand runs in a circle and so is felt finally in the electrical industry. Personally, I feel that the drop will be slow and gradual. Prices will decline slowly and wages still more slowly. This is just my own view, of course.

There seems to me to be another reason besides the one suggested why the larger motor industries did not advance their prices. During the war they increased their capacity for production to anywhere from two to twelve times that of the pre-war period. Right after the close of the war business dropped off, causing a considerable reduction in production. With the present increased production it has taken the larger companies with their increased facilities a longer time to load up to their maximum production than it has the smaller concerns.

Since the great war, during which he proved his worth and came into his own, the smaller manufacturer is more respected, is better known and has shown the buyers that his apparatus is equal to and in many cases better than that of the bigger concerns. With this improved prestige he can and does meet his larger competitor on an equal basis of price and can obtain the same interest from the buyer.

The buyers now realize that the smaller manufacturer fitted into an emergency during the period of war profits when the larger companies threw them over, and now with the rush of business the buyers are giving him the same opportunity as he had during the war. Whether they will remember the smaller concerns as the ones which helped them out and will continue to let them meet the big competitor on an equal basis when normal business conditions return remains to be seen.

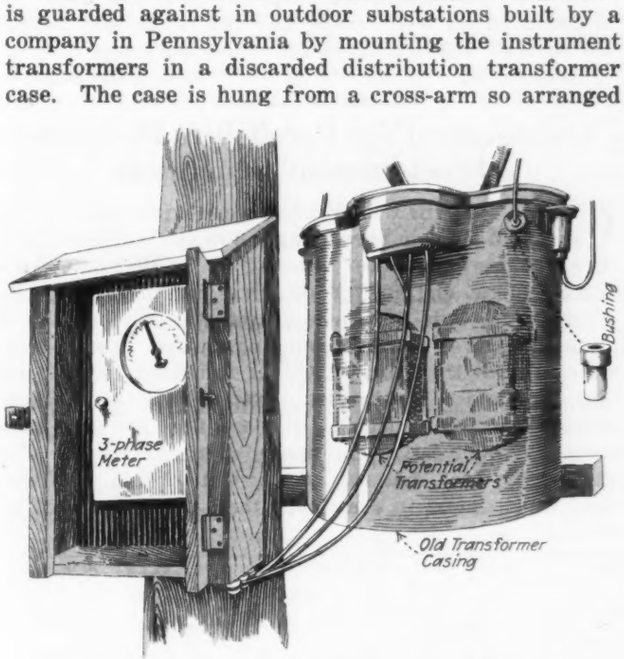
E. F. LE NOIR,
Union Electric Manufacturing Company, Milwaukee.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Instrument Transformers Mounted in Old Transformer Case

INSTRUMENT transformers are protected from the weather and accidental contact with high-voltage leads is guarded against in outdoor substations built by a company in Pennsylvania by mounting the instrument transformers in a discarded distribution transformer case. The case is hung from a cross-arm so arranged



TRANSFORMER CASE HUNG FROM CROSS-ARM ON POLE PROTECTS INSTRUMENT TRANSFORMERS

that the low-potential leads can be connected directly to the meter mounted in a wooden box next to the transformer. The meter was mounted outdoors to be near the electric furnace load and several nearby industrial plants which this substation serves. L. H. RAWSON.

Pittsburgh, Pa.

Breakage Offsets Saving on Lamps Operated Below Rating

WITH a low energy cost it may be economical to burn lamps below normal rating in order to save renewal costs through the added life of the lamp. However, in some cases another element—that of accidental breakage—may greatly offset the saving. Such was the experience of the Department of Electricity, Chicago. The cost of energy generated by the Sanitary District for this department is very low—0.44 cent per kilowatt-hour in 1918—therefore on certain street-lighting circuits it was decided to operate a 900-cp. lamp at 10 amp., which will give about 600 cp. when so operated, in place of a 600-cp., 10-amp. lamp operated normally. By exterpolating the life curve of the 900-cp. lamp a life of 7,000 hours was expected against a 2,200-hour life with the normally operated lamp. However, the actual life obtained averaged only 3,000 hours. The cause of this was a much greater amount of breakage than was thought to exist. These circuits pass through outlying districts of the city near railroad tracks and rock piles where missiles are handy for small boys to throw. It was found that five and six and even more replacements per year were made in some sections. In the worst sections it was necessary to replace the diffusing globes with steel screens of 0.094-in. (2.4-mm.) wire with 1-in. (2.5-cm.) meshes. These have practically stopped breakage where they were installed.

Another cause of breakage is lowering the lamps for cleaning. The lowering apparatus employed was that formerly used for arc lamps which have been replaced by the incandescent lamps. Although the apparatus is of the best available design, it sometimes sticks. The cleaner, who is often careless and who must clean fifty lamps a day, jerks the fixture and often breaks the filament. As many as twenty or thirty lamps have been found broken on a circuit after a careless cleaner has been over it. The apparatus is being discarded as rapidly as possible and the posts are being stepped. It was found that a workman cleaned a lamp in nine minutes by climbing the pole, which compares with seven minutes when lowering apparatus is used, provided that the apparatus does not stick. In some cases lamps have been left uncleaned on account of persistent sticking.

Henry Nixon, Deputy Commissioner of Gas and Electricity, Chicago, presented the foregoing facts before a recent meeting of the Chicago (Ill.) Section of the Illuminating Engineering Society.

Compact Kit for Testing a Wide Range of Relays

FOR testing alternating-current relays with ratings ranging up to 125 amp. on 60 cycles or 25 cycles, a compact, portable kit has been developed by the testing department of the Commonwealth Edison Company, Chicago. The entire apparatus exclusive of a cycle counter is contained in a box about 30 in. (75 cm.) long, 12 in. (40 cm.) wide and 24 in. (60 cm.) high. A switch panel is mounted at the top of the box, where all meter connections are made and switching is done. A hinged cover fits over this panel so that when open it serves as a holder for an ammeter and a cycle counter. The box is fitted with casters and has a handle on each end. There are two drawers in one side of the box for carrying small tools, notebooks, etc.

In each end at the bottom of the box is a revolving reel which holds 100 ft. (30 m.) of No. 12 lamp cord for leads to the source of supply and 50 ft. (15 m.) of connections for the relay being tested. A detachable crank carried in the drawers is used for reeling in the wire leads. Hinged doors cover the holes through which these wires are led.

A Thordarsen transformer about 9 in. by 11 in. by 10 in. (23 cm. by 28 cm. by 25 cm.) in size steps down the supply voltage from 120 volts or 240 volts to 60 volts on open circuit. The current through the relay is regulated by a specially wound reactance coil. Resistance units were formerly used for this purpose, but

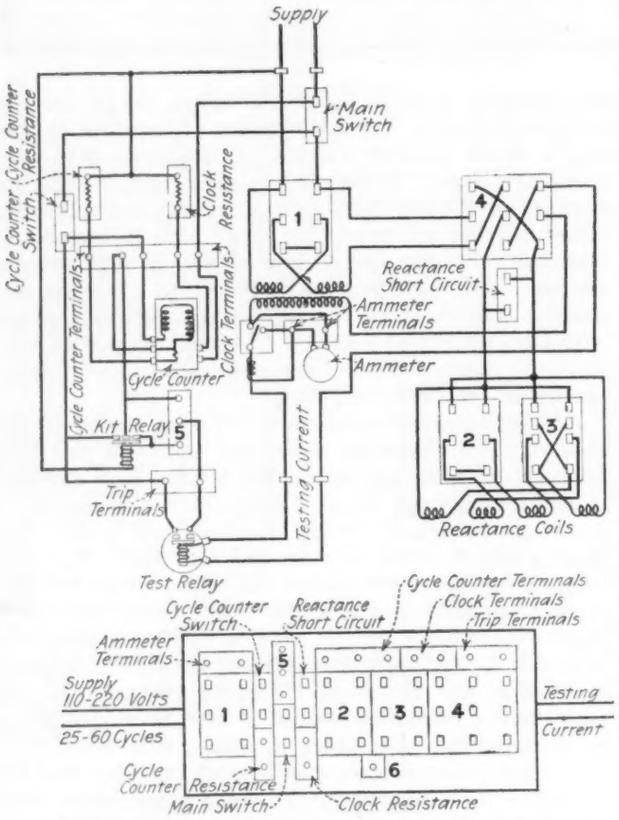


DIAGRAM OF SWITCH PANEL AND CONNECTIONS OF RELAY TEST KIT

Directions for changing connections: One up transformer coil in parallel; one down transformer coil in series; two and three down reactance coils in series; two up and three down reactance coils in series-parallel; two and three up reactance coils in parallel; four up reactance in primary; four down reactance in secondary; five up test relay stops cycle-counter directly; five down test relay operates kit relay; six up ammeter reads direct, and for six down multiply ammeter reading by 5. When using 220-volt supply remove links shorting cycle counter and clock resistances.

for the wide range of current they were necessarily very bulky. The laminated core for this reactance is U-shaped, 5½ in. (14 cm.) deep and 3½ in. (9 cm.) wide with a 1-in. (25-mm.) square cross-section at any point. Four coils of 120 turns each of No. 14 (2 sq.mm.) double-cotton-covered wire are mounted on a wooden frame so that they may slide over one arm of the core. A wooden block is fixed as an extension of this arm so that the coils may be removed from the core. The coils are taken on or off by means of a screw operated from the outside of the box with the same iron crank used on the reels. By means of switches (2) and (3) these coils may be connected in series, series-parallel or parallel, and they may be put on either the primary or the secondary side of the transformer by switch (4).

For measuring the current a 25-amp. meter is used. Above currents of 25 amp. a small current transformer (6) may be connected in the circuit, short-circuited when the meter is read directly. The ammeter is carried in a pocket at one end of the top of the box.

The Westinghouse cycle counter which is used to time the relays is connected to terminals on the panel. Resistances in series with the cycle counter for use with 240-volt circuits are short-circuited with removable links for 120-volt operation. The dial is calibrated to read directly in fractions of a second.

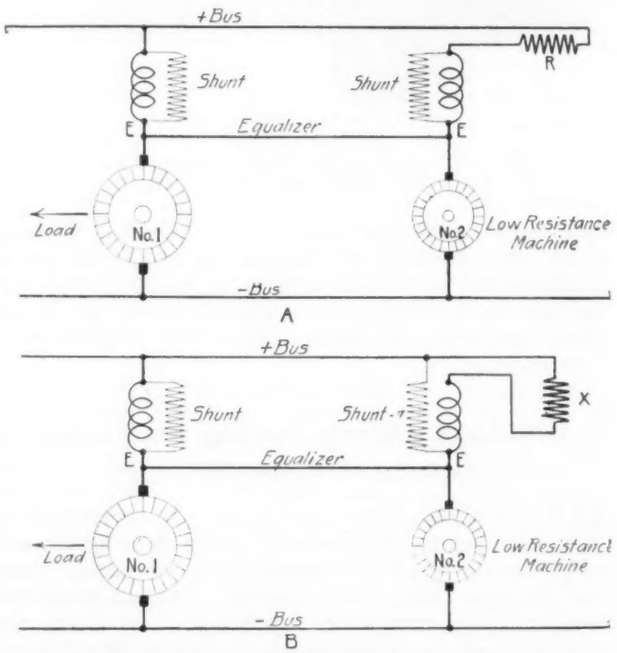
If the cycle-counter switch is in circuit, the counter begins to record when the main switch is closed and stops when the tested relay reaches the tripping point. Some relays, although they will trip an oil switch, do not maintain contact steady enough to short-circuit the cycle counter completely. Then the auxiliary kit relay must be connected in the circuit. This relay operates very rapidly (in less than one cycle) and holds itself in the tripping position after its plunger has once been raised.

All of this apparatus, excepting the two reels, is mounted on an iron frame, and the whole may be removed from the box intact for repair purposes.

Chicago, Ill. A. L. BROWNLEE.

Arrangement for Paralleling Dissimilar Direct-Current Generators

CONSIDERABLE difficulty was experienced in a certain plant in paralleling a 300-kw. turbine-driven direct-current generator running at 1,400 r.p.m. with three 300-kw. engine-type machines running about 120 r.p.m. Although the turbine unit was adjusted by a shunt to give flat compounding, when operated in parallel with the other machines it tended to seize all the load, and when the load dropped off the turbine-driven unit would drop all its load first and run as a motor. An investigation showed that the trouble was due to the fact that the series field of this unit was very much lower in resistance than the series field of



TWO METHODS TO SECURE PARALLEL OPERATION OF DISSIMILAR GENERATORS

the low-speed machines, and consequently a great deal of their current went to the board through the turbo-generator series field. Measurements showed that the resistance of the series copper alone was 0.0005 ohm for the turbine type and 0.002 ohm for the engine type.

To cure this trouble either of two methods could be

used. A resistance could be placed at *R* (diagram A) in series with the positive lead of the turbo-generator having such a value that the resistance from *E* to the positive bus would be equal for each unit, or a resistance could be placed in series with the series winding alone and the field shunt changed to the proper value. It was decided to use the latter method so a resistance of 0.0015 ohm was connected in series with the series field at *X* (diagram B), thus making the series resistance the same as that of the other units. Across the series field and the resistance *X* a shunt was installed of the same size as the shunts on the other machines. After this change very satisfactory parallel operation was obtained.

This problem will be met in cases where small high-speed machines of large output are parallel with large machines, and may arise also with motor-generators paralleled with engine-type machines. In any case, to correct the trouble, the resistance of the series circuits to the switchboard must be made inversely proportional to the ampere rating of the machines. For instance, if No. 1 machine is rated at 1,000 amp. and No. 2 at 250 amp., then the series field resistance of No. 2 must be four times that of No. 1. JAMES DIXON.

East Orange, N. J.

Periodic Inspection Saves Company $6,000 Per Year

PREVENTING breakdown of equipment by periodic inspection instead of repairing it is a practice that has saved one central-station company as much as $6,000 in one year. In the inspection systems of this country and others discussed at a recent meeting of the Empire State Gas & Electric Association the period between tests for transformer oil averages about six months. E. P. Peck, electrical engineer of the Utica Gas & Electric Company, when he was superintendent of operation, maintenance and tests with the Georgia Railway & Power Company, tested the oil in 110,000-volt transformers every three months, 66,000-volt to 11,000-volt transformers every six months and station transformers with voltages below 11,000 every year. W. C. Blackwood, electrical engineer of the New York & Queens Electric Light & Power Company, said that on account of poor ventilation the vault type of distribution transformers is sometimes tested yearly, although this is not necessary with the pole type of transformer. On taking the transformers from stock the bushings are tested and the windings are meggered in order to ascertain that the insulation has not deteriorated. Oil-switch contacts are inspected every three months by the Syracuse Lighting Company, according to D. C. Cox, while D. B. Taylor said that the Troy Gas & Electric Company inspects high-voltage switches for damaged contacts and excessive temperature every two weeks. Generators and rotaries which have been lying idle are customarily tested with a megger before starting. Mr. Peck said that he meggers reserve turbo-generators before placing in operation every two weeks even when they are operating. He also emphasized the necessity for an auxiliary trip for a steam turbine which operates in parallel with water-wheel generators, the purpose of this trip being to prevent overspeeding of the steam turbine when the waterwheels run above synchronism.

V. Poston pointed out the necessity for regularly testing generator and converter speed-limit relays and said that weekly tests were the practice of the New York & Queens Electric Light & Power Company. It is the practice of some companies, A. M. Perry of the ELECTRICAL WORLD said, to obtain from the manufacturers the maximum allowable hot-spot temperature of their equipment and, by means of temperature indicators connected to thermocouples therein, to limit the load on the machines according to actual temperature indicated rather than by nameplate rating. In examining rotary converters Mr. Peck thought particular attention should be paid to the nuts holding the squirrel cage. In the Georgia plants, of which he formerly had charge, the end shields of generators were removed for inspection every three months. The temperature of turbine bearings is noted hourly during operation, according to H. W. Morreall, Utica Gas & Electric Company.

To facilitate inspection Mr. Taylor recommended the truck-type switchboard. He stated that in a Pittsburgh company, where a 30,000-kw. board of this type is installed, an 11,000-volt panel can be changed in one and a half minutes. A different opinion was held by W. C. Pearce, superintendent Syracuse Lighting Company, who said he did not see the advantage of the truck-type board when a spare permanent board can be easily provided. Sydney Alling said that the Rochester Railway & Light Company has an arrangement for connecting feeders outside the station when feeder apparatus inside is to be inspected, so that a truck-type board would not add any advantages. Mr. Blackwood stated that this type of board is used by his company for high-tension customers' substations to permit standardization and provide safety.

Precaution Taken to Avoid Outage of Emergency-Circuit Lamps

ON THE ceiling above each emergency lamp in the power plant of the Louisville (Ky.) Gas & Electric Company is painted a red circle. This indicates that the fixture below it is on the emergency lighting circuits and reminds observers that outages must be remedied immediately.

Losses in 33,000-Volt Transmission Network

IN A 25-CYCLE transmission system in Missouri which includes 175 miles (105 km.) of 33,000-volt transmission lines and two transformations, the losses over a period of two years averaged about 9 per cent. The energy in this system is generated at 6,600 volts, stepped up to 33,000 volts through transformers aggregating 42,800 kva. and sold partly at this voltage and partly at 2,300 volts, the 33,000/2,300-volt transformers aggregating 27,500 kva. About 80 per cent of the transmission lines are of No. 0 (53.5 sq.mm.) hard-drawn copper, and the remainder are practically all of No. 4 (21.1 sq.mm.) hard-drawn. The losses of this company, the Empire District Electric Company, Joplin, Mo., between the 66,000-volt side of the step-up transformers and the delivery point are shown here for the two years:

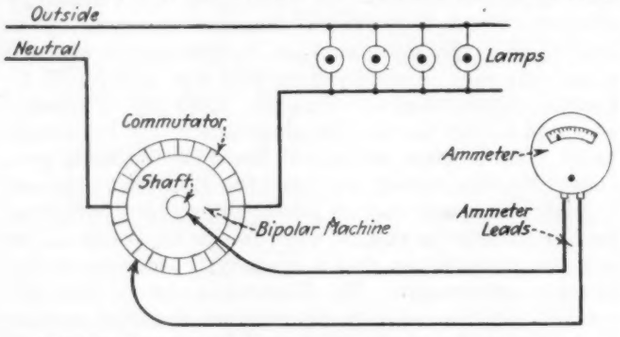
Annual Maximum Demand	Annual Load Factor	Average Loss, Per Cent	Lowest Monthly Loss, Per Cent	Highest Monthly Loss Per Cent
23,500	57.5	8.56	6.84	10.12
24,300	51.5	9.53	7.56	11.48
Average— 23,900	54.5	9.05	7.20	10.80

Industrial Applications

The Economical Utilization of Electrical Energy
in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Grounds on Direct-Current Machines Located with Ammeter

FOR locating grounds in the armature of direct-current machines without lifting the commutator leads a Long Island repair shop employs an ammeter in conjunction with current from a lighting circuit. Flexible leads as shown in the diagram are attached to the commutator with a bank of lamps in series with the leads and on the live leg of the direct-current system. If the bank is connected to the neutral wire, there is danger of short circuit should the rotor touch a grounded object. These leads are placed the same distance apart as adjacent brushes of the machine are normally spaced. Then one lead of an ammeter of sufficient size to carry the full lamp lead is attached to the motor shaft while the other lead is moved around the commutator. When the ammeter reading is lowest the lead is on the commutator bar to which the grounded coil is attached. In case the lowest reading occurs at two different points, the leads from the lamp bank must be shifted and more readings are then taken with the ammeter.



TESTING FOR GROUND WITH LAMP BANK AND AMMETER

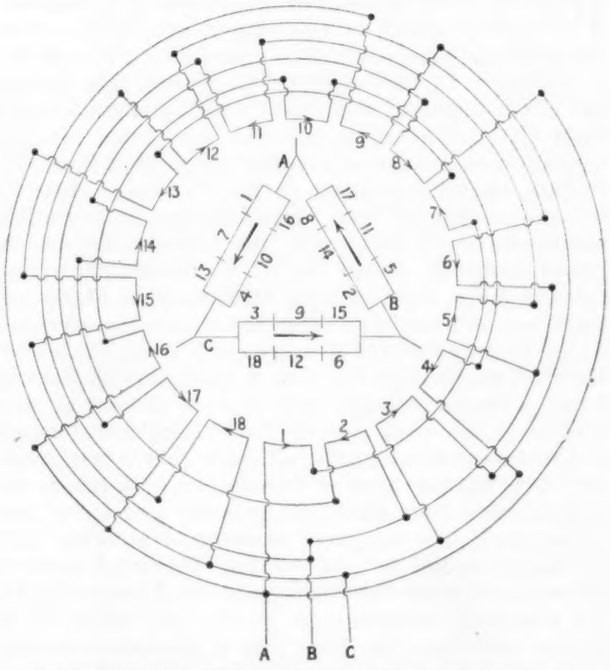
New York City, N. Y. THEO. C. KATSIGRIS.

Rewinding 220-Volt Induction Motor for 110 Volts

A 25-HP., 220-volt, six-pole induction motor was recently sent to a New York repair shop for rewinding to operate on 110 volts. By changing the stator winding and the coil throw this was accomplished without altering the rotor. The machine was originally built to run 1,200 r.p.m. on three-phase, 60-cycle energy. There were seventy-two coils of five turns of 0.18-in. x 0.11-in. (4.6-mm x 2.8-mm.) single cotton-covered ribbon, laid with a pitch of one to twelve in the seventy-two slots and connected as shown in the diagram in two-parallel delta.

In rewinding for 110 volts the number of turns per phase should be reduced by one-half, provided that the same pitch was used, but as one-half of five gives two and one-half turns, an impossible condition, the number of turns had to be taken as either two or three. The latter value, three turns per coil, was chosen, and the chord factor was diminished by decreasing the pitch in order to make the voltage approximately 110 volts. To determine the correct pitch the formula $(5 \times 0.9914)/(3 \times P) = 220/110$ was used, in which 0.9914 is the chord factor for the five-turn coil, giving 220 volts, and P is the chord factor for the three-turn coil, giving 110 volts.

Solving this equation, it is found that $P = 0.8262$, which is the sine of about 55.5 deg., or 111/2 deg. But full pitch equals $72/6 = 12$, and the angle between slots is 180/12 deg., or 15 deg. Therefore $113/15 = 7.4$ slots is the proper span for 110 volts. The coils were consequently laid with a pitch of No. 1 to No. 8, spanning seven slots, which gives a chord factor of sine $(7 \times 15)/2$ deg. $= 0.793$, and a voltage of 105 volts. As this voltage is only about 5 per cent below normal and as modern motors are designed to operate with 10 per cent voltage variation, it was thought that the motor would operate satisfactorily if rewound with this pitch. Accordingly, it was wound with a pitch of one to eight with seventy-two coils of three turns of 0.18-in. x 0.2-in. (4.6-mm. x 5.1-mm.) double-cotton-covered ribbon and connected two-parallel delta as before.



CONNECTION OF THREE-PHASE, SIX-POLE, TWO-PARALLEL, DELTA-WOUND INDUCTION MOTOR

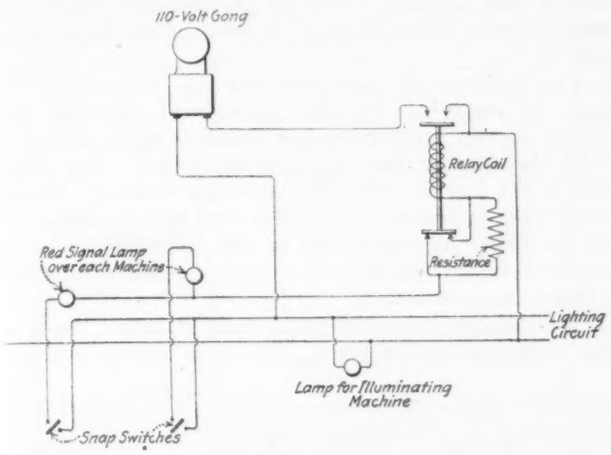
Diagram applies to motor wound for 220 volts and also to motor rewound for 110 volts. Number of turns per coil was decreased from five to three, pitch was decreased and wire size was doubled.

After reassembling, the motor was given a ten-hour load test and was found to run in a perfect manner.

New York City. C. A. JOHNSON.

Signal Lamp to Call Machinist in Composing Room

USUALLY when a linotype machine in a printing establishment is out of order the operator waits for the machinist to come past his machine rather than attempt to find him. This wastes time and tends to reduce shop production. A printing concern in the East has, therefore, installed a signaling system by which the linotype operator may give the machinist notice of a breakdown by simply pressing a switch button on the linotype. This rings a bell indicating that some machine is in need of attention, and it also closes the circuit to a



WHEN CIRCUIT IS CLOSED BELL RINGS AND SIGNAL SHOWS WHICH MACHINE NEEDS REPAIR

red lamp mounted on the machine frame to indicate which machine is out of service.

This installation was made at a very slight cost as the main illuminating circuit wires were utilized, thus necessitating only one additional wire for the signal lamps. The simultaneous operation of the bell and lamp is obtained in an interesting manner as shown in the diagram. When the switch is closed the lamp lights, but at the same time the relay is actuated so as to close the bell circuit. When the bell circuit is closed a resistance is automatically inserted in the relay coil circuit to prevent its overheating. L. C. HEFTNER.

New York, N. Y.

Residual Magnetism Causes Relay Armature to Stick

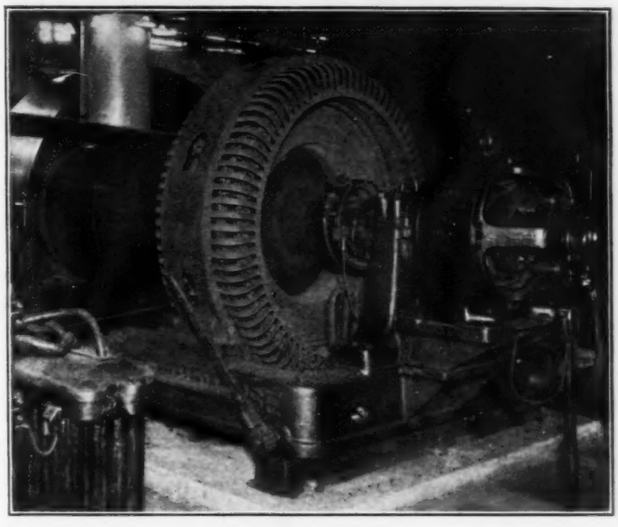
RESIDUAL magnetism holding the armature of a relay against the force of gravity was responsible for much trouble in the operation of an air compressor in North Carolina where the starting and stopping of the compressor was controlled by the reservoir pressure. This relay is the starting relay for a 25-hp. slip-ring induction motor which drives the compressor. The motor voltage is 2,200 volts and that of the control panel is 220 volts. By means of a pressure gage connected to the relay when the pressure rises to 40 lb. (2.8 kg.) the relay is energized and the armature is raised, thereby opening the control circuit and stopping the motor. The armature is held in this position until the pressure falls to 20 lb. (1.4 kg.) when the operation of the pressure gage breaks the circuit through the relay so that the armature should drop to start the motor again.

After a few weeks of operation of the plant it was found that sometimes the motor failed to start when the pressure fell below 20 lb. and the relay had to be tripped by hand. In attempting to remedy the trouble a new pressure gage was put in, but this did not improve the operation. After a bell had been connected to the gage so that it would ring when the pressure decreased below the limit, it was found that the gage worked perfectly but that the armature of the relay remained raised even when no current was flowing through the coil. The residual magnetism in the relay was sufficient to hold up the armature. The design of the coil was responsible for this, as the armature when raised pressed directly against a stationary iron core. A very simple remedy for the trouble was to attach a thin brass ring on top of the armature so that the two pieces of iron can not come into actual contact. Since this ring has been added no trouble from this source has been experienced.

Salisbury, N. C. J. H. ROBERTSON.

Synchronous Motor Saves $30,000 a Year in Refrigerating Plant

A SAVING of $30,000 a year has been effected for the Sheffield Farms Company, New York City, by replacing steam engines with a synchronous motor drive. This motor, a 500-hp. Westinghouse 440-volt machine, drives through a belt connection four 80-ton and one 12-ton ammonia compressor, two 14-in x 10-in. (35.6-cm. x 25.4-cm.) air compressors and two generators of 110



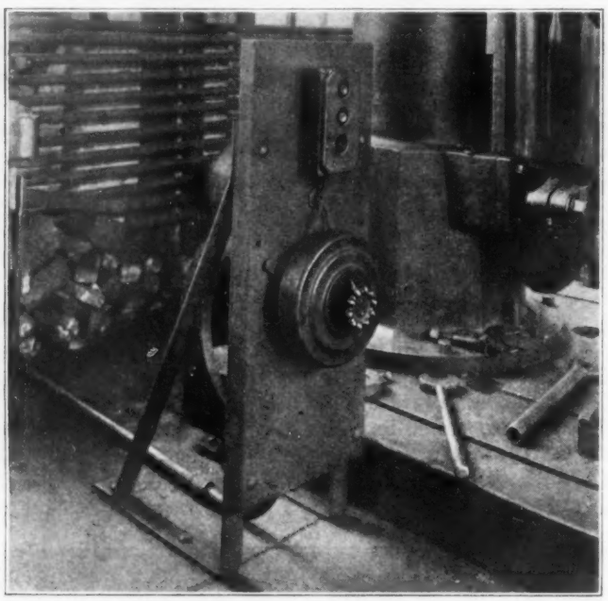
SYNCHRONOUS MOTOR-DRIVING COMPRESSOR HAS INCREASED EARNINGS IN THIS PLANT

kw. and 125 kw. respectively. Although the installation is not well arranged for motor drive, the saving and increase in capacity have been large. The synchronous motor is better adapted to driving such a refrigerating plant than an induction motor because of its high efficiency, uniform speed and high power factor. The starting torque is small since by-passes are commonly used.

A valuable feature of the installation is the curve-drawing meter which indicates immediately any change in load caused by trouble developing in the refrigerating machinery, such as worn parts, change in temperature of brine or water, etc. A variation in the recorded curve immediately shows that trouble is present.

Home-Made Floor Stand for Remote Control of Machine Tool

A CONVENIENT floor stand to hold the control buttons and speed-regulating rheostat of a 42-in. (107-cm.) Warren radial drill in the Chapman Valve Manufacturing Company shops was made by bolting a heavy pine slab to a strap-iron frame bolted to the concrete floor. This was a case where the control could not be mounted on the machine but where it should be convenient to the operator. So a switch



MOTOR CONTROL NEAR MACHINE

box with the forward, reverse and stop buttons and a control rheostat are mounted on this 36-in. x 14-in. x 1¾-in. (92-cm. x 36-cm. x 4.5-cm.) slab near at hand. For fastening the frame of 2-in. x ⅜-in. (51-mm. x 9.5-mm.) iron to the floor 0.5-in. (1.3-cm.) bolts are screwed into lead-lined holes. This lead lining is made by fastening an oiled bolt upright in the hole which has been drilled in the floor and pouring molten lead into the hole around the bolt. As soon as the lead cools the bolt is withdrawn by unscrewing and this lead screw-hole forms a good anchor for holding the frame. There was no trouble encountered from shrinking of the lead in cooling.

Indian Orchard, Mass. WALTER B. ATCHINSON.

Testing Contact of Knife-Switch Blades

IN ORDER to be assured that the blades of switches make good contact with the jaws, a "feeler" is sometimes used. This device can consist of any thin. hard material, but usually a piece of mica, about ⅜ in. (9.6 mm.) wide and a couple of inches long, is satisfactory. A very thin piece of sheet steel will also serve. The feeler should be about 0.003 in. (0.76 mm.) thick.

To use the tool, insert it between the jaws and the blades at different points. At locations where it can be pushed in readily the contact is poor. Such difficulties may be corrected by light hammer blows on the jaws. The blade should always be "ground in" to insure good contact between it and the break jaws.

Denver, Col. H. J. WADE.

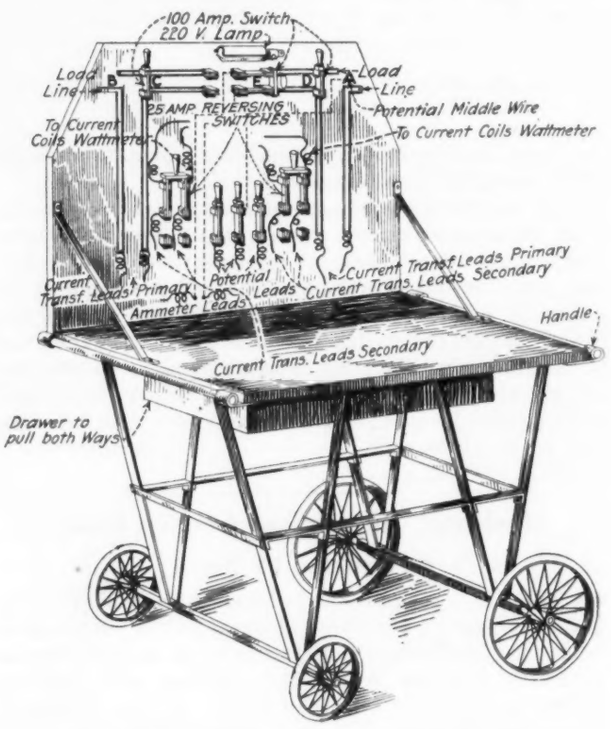
Portable Testing Table for Industrial Plant

IT IS very essential to know the conditions under which motors are operating, particularly if machines are of special design. Various methods and apparatus have been developed to help in determining these conditions.

The portable testing table shown in the accompanying illustration has been used by the writer eight years and has been found very satisfactory. This table, with current transformers, polyphase wattmeter, ammeter and voltmeter, is wheeled to the motor to be tested and connected thereto by dummy fuses and flexible cable leads attached to the testing table at *A* and *B*.

The instruments are connected in the motor circuit by removing the live fuses and allowing the motor to run single-phase an instant while replacing with the dummy fuse properly connected. The other leg of the line is connected in a like manner. Potential leads are connected by lamp cord to the middle leg of the line. All conductors on the front of the board are of polished copper bars ¾ in. wide and ⅛ in. thick (19 mm. by 3 mm.).

The dummy fuses are made from standard fuses of the sizes used in the plant. The fuse wire is removed



TEST TABLE MAY BE ROLLED TO MOTOR SWITCH

and the interior is filled with sealing wax so that the fuse will keep its shape under continuous handling. If the fuse is of the knife type, the blades are soldered to the end ferrules in order to insure solidity and good connection. The leads are soldered to the ferrule and a small copper strip is bolted around them to keep them from pulling off.

I. H. GASKIN,
Electrical Engineer.

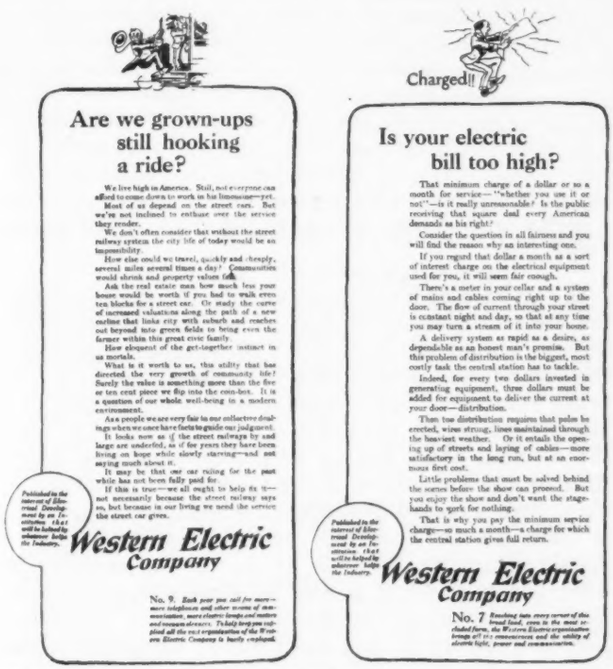
Gillette Safety Razor Co.,
South Boston, Mass.

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

Building Good Will for the Industry

THROUGH advertisements in several of the popular magazines the Western Electric Company is now conducting an educational campaign designed to build good will for the several branches of the industry. Eleven advertisements have been prepared that deal with some common problem in the home or business life of the average citizen and carry a common-sense appeal for fair play and a better understanding of electric service in all its phases. Two of the advertisements are reproduced here. The nine others are similar and are written from the standpoint of the electric street railway, electrical contractor, architect, telephone company, underwriters and steam railroad.


Are we grown-ups still hooking a ride?
Western Electric Company
Charged!!
Is your electric bill too high?
Western Electric Company

COMMON SENSE APPEALS TO THE PUBLIC THAT INSPIRE FAIR PLAY AND AN APPRECIATION OF JUST WHAT ELECTRIC SERVICE MEANS IN THE AFFAIRS OF TODAY

C. G. Du Bois, president of the Western Electric Company, in referring to this campaign, says: "We seek for ourselves as a company to build according to ideals that will be in harmony with the changing ideals of the times. Our effort, it seems to us, must go beyond the physical and commercial growth of our nation-wide system of distributing houses. We must seek to understand alike the problems of the producer from whom we buy and of the customer whose trade we seek, so that we may interpret each to the other. If we can aid both to be better understood by the public which both, like ourselves in the last analysis, must serve, we shall of course be aiding all those in the great industry of which we ourselves are only a part. But we believe that only to the extent that we serve the whole electrical industry can we share in the hoped-for and well-deserved prosperity of an industry that is of incalculable benefit to civilization. These advertisements, editorially written to you—the central station, the contractor, the engineer, the telephone company, the architect, the railroad—are the expression of our belief in this helpfulness. Their purpose is selfish to the extent that it is selfish for the whole industry, of which for fifty years we have been a part. Occupying as manufacturer and jobber a neutral zone, holding no brief for one department of the industry as against another, we have chosen to treat those organized divisions of it which the American people recognize as serving them."

Net Earnings of Dayton Company Increased 37 Per Cent

A SUBSTANTIAL increase in the business of the Dayton (Ohio) Light & Power Company for the year ended Dec. 31, 1919, is shown in its recent report to stockholders. Gross earnings increased $502,139.35, or 20.60 per cent, over 1919, while operating expenses for the same period increased only $213,957.48, or 12.87 per cent, making an increase of $288,187.87, or 37.49 per cent, in the company's net revenue. The output in kilowatt-hours increased 14.62 per cent, and steam supplied for heating purposes was 28.32 per cent more than in 1918.

Growth of the Dayton company's business is evidenced by the addition during 1919 of 5,083 meters installed and 13,841 hp. connected. During the past year negotiations were completed for supplying energy for four villages formerly served by municipally owned plants.

Forty-six miles of high-tension transmission lines were built during the year, connecting eleven additional towns and communities, making a total in all of fifty-seven in the territory served. The total additions and betterments to the plant and property for 1919 amounted to $1,094,026.

Safeguarding Employees' Health

A DENTAL clinic has been established by the Union Electric Light & Power Company, St. Louis, Mo., for the benefit of its employees. Taking the names in alphabetical order, the employees will be notified every fourth month to appear at the clinic for a dental examination. The teeth will be cleaned and extractions made where necessary absolutely free, while fillings, crowns, bridge work, etc., will be charged for at the bare cost.

Infections in the mouth and blind abscesses at the roots of the teeth are the cause of many diseases, and it is felt that absence from duty because of sickness will be lessened by the work of the clinic.

Handling of Customers' Orders

BY CHARLES A. COLLIER
Contract Agent, Georgia Railway & Power Company

USUALLY the only point of contact between the average customer and the company is the order department, and inevitably lost motion, inefficiency, haste or discourtesy in that department leaves an unfavorable impression on the customer's mind. If his order is handled promptly, courteously and efficiently, his opinion of the company is enhanced.

With this idea in mind, the Georgia Railway & Power Company, a combination gas and electric company with approximately 27,000 gas and 24,000 electric customers, decided in the summer of 1919 to install a new system of handling customers' orders. Under this new system, at the same time the customer's order is written, other records, such as line orders, connected load records and a work sheet for the line and meter

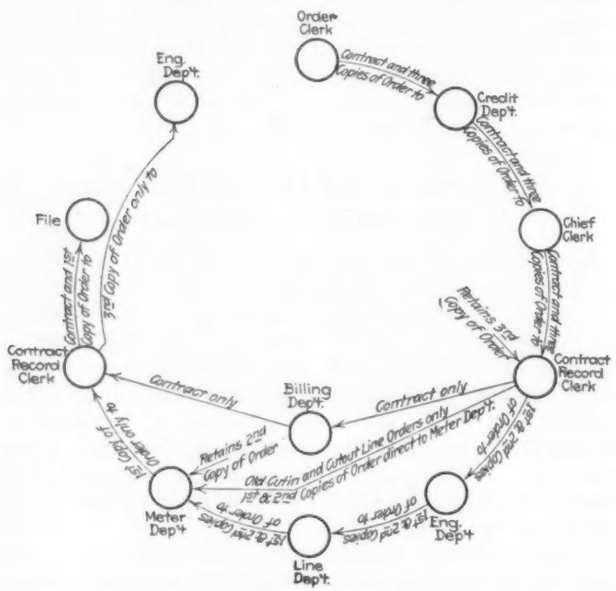

Order Clerk
Contract and three Copies of Order to
Credit Dep't.
Contract and three Copies of Order to
Chief Clerk
Contract and three Copies of Order to
Contract Record Clerk
Retains 3rd Copy of Order
Contract Record Clerk
Contract only
Billing Dep't.
Contract only
Retains 2nd Copy of Order
Old Cut-in and Cut-out Line Orders only
1st & 2nd Copies of Order direct to Meter Dep't.
1st Copy of Order only to
1st & 2nd Copies of Order to
Meter Dep't
Line Dep't.
Eng. Dep't.
Contract and 1st Copy of Order to
File
3rd Copy of Order only to
Eng. Dep't

FIG. 1—ROUTINE FOR HANDLING NEW CUT-IN, OLD CUT-IN AND CUT-OUT LINE ORDERS

departments of the electric company and the gas shop of the gas company, are made out in a single operation.

This is made possible by providing four forms, consisting of an original and three copies, which are filled out in the case of straight gas and straight electric orders. In the case of a combination order (gas and electric) an original and six copies are made. As shown in the accompanying illustrations, the original contains the agreement which the customer signs, while the carbon copies serve the following purposes:

In the case of electric orders, copies No. 1 and No. 2 go to the line department. When the line work is completed these two copies are forwarded to the meter department, where the second copy is used as a work sheet. After the setting of the meter the first copy is returned to the contract record department, where the third copy has been held as a memorandum order. It is there attached to the original application and filed. The original application is sent to the consumers' billing department at the same time the customer's order goes to the line department and upon entry by the consumers' billing clerk is returned to the contract record department for final filing.

Application of
NAME Smith, Jno. W.
ADDRESS 301-10th St.
TO GEORGIA RAILWAY & POWER COMPANY, ATLANTA, GA.
DATE 1/27/20
No 2402
TRANSFER FROM Brown, Hdw. Co.
To Begin Feb 1 1920
REMARKS: Residence
Old Wiring
Old Cut In O.K. Due
SYSTEM
PHASE
Connected Load 2.5 — 30 WATT EQ.
H.P.
LIGHT
HAS GAS

SPECIAL NOTICE: The rates stated in the following proposal or contract are subject to change by the Railroad Commission of Georgia in the manner prescribed by law at any time. In the event of such change the new rates prescribed by the Railroad Commission will apply from the date made effective for the unexpired term of this contract.

TO GEORGIA RAILWAY & POWER COMPANY:

Under and in accordance with your Rules and Regulations and at your regular rates of charge on file with the Railroad Commission of Georgia, and with such modifications and additions as may from time to time be made thereto and filed with said Railroad Commission, to all of which the undersigned applicant agrees, you are requested to supply your electric service for an aggregate connected load as stated above to the premises at the above address for the term of one year and thereafter for successive periods of one year each until either party shall give to the other notice in writing of a desire to discontinue this contract at least sixty days prior to the expiration of the term of this contract or any existing renewal term of the same.

The undersigned agrees to pay for such service promptly each month according to the statement shown by the meter, at the regular rates of schedule applicable to such service and according to your rules. The minimum payment for each month, in the event that the current consumed during such month should at the regular rates amount to less than such minimum, shall be that set forth in the regular rates of schedule applicable to such service.

The undersigned agrees to pay on demand ..... Dollars for making connection to Company's distribution system.

Accepted this .....

GEORGIA RAILWAY & POWER COMPANY,

By ..... Sales Manager.

By ..... Mailing Address.

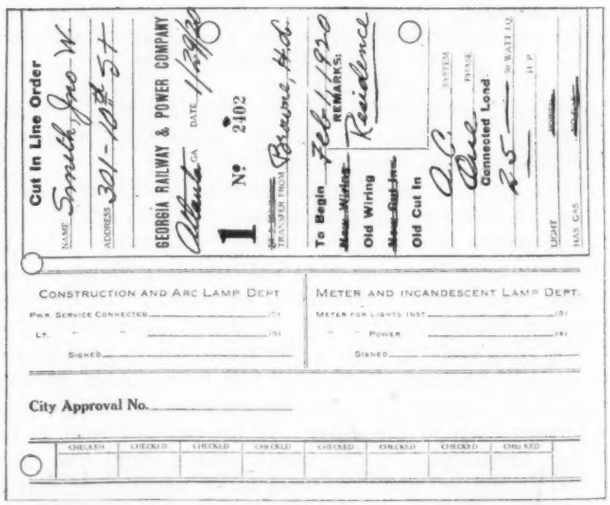
Rates applicable to this application: Schedule.

LOCATED ENTERED
BY
FILED CHECKED
BY

DISTRICT | KIND OF BUSINESS | CLASS OF SERVICE

FIG. 2—APPLICATION FORM WHICH IS ACCOMPANIED BY THREE COPIES OF THE FORM IN FIG. 3, ALL BEING FILLED OUT AT ONE TIME

In the case of a combination gas and electric order the electric routine remains as outlined above, while the gas orders are sent direct to the gas shop, where the second copy is used as a work sheet, the first copy being returned to the contract record department for attachment to the application. After that it is filed, the original order having been entered in the meantime by the consumers' billing clerk and returned to the contract record department. The third copy, which is held by the contract record department as a memorandum, finally finds its way to the engineering department, where it is filed by streets as part of the load records, displacing the cards which it was necessary theretofore to have made out by a separate clerk.


Cut In Line Order
NAME Smith, Jno. W.
ADDRESS 301-10th St.
GEORGIA RAILWAY & POWER COMPANY, ATLANTA, GA.
DATE 1/27/20
1 No 2402
TRANSFER FROM Brown, Hdw. Co.
To Begin Feb 1 1920
REMARKS: Residence
Old Wiring
Old Cut In O.K. Due
SYSTEM
PHASE
Connected Load 2.5 — 30 WATT EQ.
H.P.
LIGHT
HAS GAS

CONSTRUCTION AND ARC LAMP DEPT.
PWR. SERVICE CONNECTED ..... 19..
LT. " " ..... 19..
SIGNED .....

METER AND INCANDESCENT LAMP DEPT.
METER FOR LIGHTS INST. ..... 19..
" " POWER ..... 19..
SIGNED .....

City Approval No. .....

CHECKED | CHECKED | CHECKED | CHECKED | CHECKED | CHECKED | CHECKED | CHECKED

FIG. 3—LINE ORDER FORM WHICH BEARS A CARBON COPY RECORD OF INFORMATION ON APPLICATION (FIG. 2) FOR SERVICE

This routine may be more readily understood by reference to the diagram showing the routes the orders follow. In the application forms also shown it will be noted that practically all information required by the departments concerned is contained on the face of the application. An extra-hard indelible pencil insures legible carbons. The size and mechanical arrangement of all orders, which are made up in pads with the proper number of copies, are such as to permit their being folded to fit the proper files and metermen's work book, thus standardizing the size and shape of all customers' orders.

This system was put into operation on October 6, 1919, and the work it eliminated has enabled the contract and contract record departments to reduce the clerical force by five persons in these departments alone and at the same time expedite the handling of the order, despite the fact that the year 1919 shows an increase in customers of 10 per cent over the year 1918, while customers' orders show an increase of 26 per cent over the corresponding period of last year.

Not only is the routine thus simplified, but the order clerks are now able to take the customer's order intelligibly in about half the time formerly required. Since all the data necessary are printed on the face of the application, there is a constant reminder to the clerk that he must obtain from the customer the data requested before the order goes through, thus eliminating many omissions and reducing the errors.

Increase in Lighting Business of Buffalo General Electric Company

THE annual report to stockholders of the Buffalo (N. Y.) General Electric Company through its statement of revenues and expenses for the year ended Dec. 31, 1919, shows interesting developments in the company's business. In spite of a reduction in its revenue from commercial power of approximately $464,000, or 14 per cent, the revenue from lighting increased so that the total reduction in sale of energy was less than three-quarters of 1 per cent, while the total gross income was increased about 7 per cent. An increase in street lighting of 4 per cent is shown, in municipal lighting of 16 per cent, in residence lighting of 37 per cent and in commercial lighting of 15 per cent. The total increase in domestic and commercial lighting business of $416,580 during 1919 was nearly 8 per cent of the total sale of energy for 1918.

Through a reduction in the cost of power due to the purchase of coal at a lower price than in 1918 and the use of Niagara power, the cost of power was about 14 per cent less for 1919 than in 1918. The report, therefore, shows an income from operation approximately 10 per cent more in 1919 than in the previous year and a net income after other non-operating additions and deductions of about 23 per cent more than 1918. Under the heading "expenses" an increase is shown in system operation of 27.5 per cent and in taxes of 8.5 per cent.

Owing to the termination with the coming of peace of arrangements by which a large amount of electrical energy was diverted to the industries at Niagara Falls under the direction of the Government the output of the company's 90,000-kw. steam station was reduced from 252,000,000 kw.-hr. in 1918 to 190,000,000 kw.-hr. in 1919.

Why Patronize the Junk Dealer?

THERE is always a certain amount of waste material which is to be found around the offices and power plants of a power company. Too often, in the zeal of cleaning up, the combustible portions of this accumulation are piled up and touched off with a match, while the unassorted mass of scrap iron is sold to the nearest junk dealer for a few dollars. The poolings of power companies which have taken place in the West in the last few years have led to many such scrap heaps in the sorting out of duplicate material. The great posibilities which lie in the "junk pile" have been disclosed by H. N. Sessions of the Southern California Edison Company, who handled one such special "clean-up" at the time of the merging of the Southern California Edison and the Mount Whitney Power Company systems.

Much of the material which could be put into good condition was sold to other companies at prices that, owing to the present high level, were often equal to or greater than the original amount paid for the property.

Of the scrap material, there was much which could be sold in other markets than that provided by the ever-ready junk dealer and bring from eight to ten times the return. Arc globes make excellent fishbowls. Other shapes of glassware could be sold to florists and nurserymen for potted plants. Glass reflectors made fruit dishes. Marble switchboards find a market with the baker, or even with the housewife who does extensive baking in her own kitchen. Linemen's gloves which are no longer safe for this use may still afford protection for workmen handling injurious chemicals and will bring as much as $1 per pair, whereas the junkman will offer only a few cents for the leather. Harness makers provide a market for scrap leather belting, sawmills for odds and ends of manila rope, which will bring from 8 cents to 20 cents per pound, in contrast with the ordinary price of 4 cents per pound. A little exploring in each case revealed buyers at hand who were willing to pay well for carefully assorted material.

The importance of careful sorting is nowhere greater than in the case of scrap iron. Cast iron, cast steel, wrought iron and various types of wrought steel have each a different market, rods, tubes and like special parts sometimes bringing fancy prices as compared with the sum offered for mixed material. The Southern California Edison Company found it expedient to take out a scrap dealers' license during war time, when all prices were fixed by the United States Steel Administration, with the advantage in favor of regular dealers.

The general practice by the company is not to publish a list of material available, but to advertise a miscellaneous assortment of scrap to meet all kinds of needs and accustom possible buyers to make a statement of just what they want. The mechanism of handling is very simple. All obsolete or surplus material from every department and division of the system is forwarded to a central clearing house, where it is passed on by a committee of engineers. If it is found not available for use in any part of the company's work, it is then turned over to the chairman of this committee, the commercial engineer of the company, for salvage at the greatest possible profit.

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
of the World

Motors, Generators and Transformers

Subdivided Conductors for Alternating-Current Machinery.—L. FLEISCHMANN.—To cut down eddy-current losses in armature conductors carrying alternating current subdivided conductors are used, the different bars being systematically transposed. The author shows that in order to get the same current in each subdivision of the conductor the integral $\int y_2 dx$, taken over the length of the slot must be equal for each subdivision. y is here the distance from the conductor to the bottom of the slot, and x is measured along the slot. This condition implies that the center of gravity of the surface between the bottom of the slot and the conductor must, for all subdivisions, lie at the same distance from the bottom of the slot.—*Archiv für Elektrotechnik,* Oct. 10, 1919.

Losses in Transformers.—REGINALD C. KAPP.—This is a study of the proper division of iron and copper losses in a transformer in the light of the probable actual use of the transformer during a year.—London *Electrician,* Feb. 13, 1920.

Polyphase Windings.—RUDOLPF RICHTER.—The author develops the theory of fractional-pitch windings; that is, windings for polyphase machinery where the tooth pitch is not an even submultiple of the pole arc. For a great number of different cases the layout of different kinds of winding is shown in winding diagrams and tables.—*Archiv für Elektrotechnik,* Oct. 10, 1919.

Lamps and Lighting

New Intensive Street Lighting.—W. D'A. RYAN.—A new "white way" has been established in Los Angeles which is said to represent one of the best types of intensive street lighting in existence in the United States. —*Journal of Electricity,* Feb. 15, 1920.

Generation, Transmission and Distribution

Electrical Characteristics of Transmission Circuits, VII.—WILLIAM NESBIT.—In this article the author considers the performance of short transmission lines in which the effect of capacitance is not taken into account. The Mershon and the Dwight charts are printed and methods of solving transmission line problems are given when either the voltage at the sending end or at the receiving end is fixed.—*Electric Journal,* February, 1920.

Power-House Foundations. — E. M. LURIE. — The writer considers methods of testing soils, column footing, draining and other construction problems in connection with securing permanency of foundation.—*Power Plant Engineering,* Feb. 1, 1920.

Power from the Tidal Flow at Hopewell.—W. RUPERT TURNBULL.—The three great desiderata for a tidal plant are said to be: (1) That there should be sufficient height of tide to obtain a good head; (2) that there should be two natural reservoirs of large size so that continuous power can be obtained; (3) that power plants should be central to the population that would be served. It is also said that conditions are favorable in these respects at Hopewell for the installation of a plant of 200,000 hp. ultimate capacity. The author estimates that the cost per horsepower of this installation would be $122.50 for the first 100,000 hp.—Toronto *Electrical News,* Feb. 15, 1920.

Calculation of Saga Sag.—P. O. SZILAS.—A new method for calculating sag in aërial transmission lines is described, and a set of graphical charts is presented by the aid of which sag and tension may be quickly determined for different temperatures and spans and for wires of different sections of copper, aluminum, bronze and soft and hard steel.—*Elektrotechnische Zeitschrift,* Sept. 25 and Oct. 2, 1919.

Recent Advances in the Utilization of Water Power.—E. M. BERGSTROM.—The outstanding features in the development of the utilization of water power are summarized as follows: (1) The exclusive use of two types of turbines only, namely Francis reaction turbines for low and medium heads and Pelton impulse wheels for high heads; (2) the extension of the use of Francis turbines under heads approaching 800 ft. (240 m.) and Pelton wheels in single stage up to 5,500 ft. (1,680 m.); (3) the exclusive adoption of balanced wicket

AVAILABLE WATER-POWER IN THE PRINCIPAL COUNTRIES OF EUROPE AND AMERICA

Country	B.-hp. Available	B.-hp. Developed		Area in Square Miles	Population	B.-hp. Available per Square Mile	B.-hp. Developed per Square Mile	B.-hp. per Capita	
		In B.-hp.	In Per Cent					Available	Developed
United States	28,100,000	7,000,000	24.9	2,973,890	98,783,300	9.4	2.35	0.28	0.071
Canada A*	18,803,000	1,735,000	9.2	2,000,000	8,033,500	9.4	0.87	2.34	0.216
Canada B	8,094,000	1,725,000	21.3	927,800	8,000,000	8.7	1.86	1.01	0.216
Austria-Hungary	6,460,000	566,000	8.8	261,260	51,173,000	24.8	2.17	0.13	0.011
France	5,587,000	1,100,000	11.6	207,500	39,601,500	26.8	3.14	0.14	0.016
Norway	5,500,000	1,120,000	20.4	124,130	2,391,780	44.3	9.62	2.30	0.468
Spain	5,000,000	440,000	8.8	190,401	19,588,700	26.3	2.31	0.26	0.022
Sweden	4,500,000	704,000	15.6	172,960	5,522,400	26.0	4.08	0.81	0.127
Italy	4,000,000	976,000	24.4	91,400	28,601,600	43.8	10.7	0.14	0.034
Switzerland	2,000,000	511,000	25.5	15,976	3,781,500	125.2	32.0	0.53	0.135
Germany	1,425,000	618,100	43.4	208,800	64,926,000	6.8	2.96	0.02	0.010
Great Britain	963,000	80,000	8.3	88,729	40,831,400	10.9	0.91	0.20	0.002

* A includes Yukon and northern area improbable of immediate development.

gates for regulation of Francis turbines and the circular nozzle with combined deflector and needle regulation for Pelton wheels; (4) the standardization of turbine runners and increased specific speed, permitting the use of single vertical units of large output under low heads; (5) the general increase of output per unit, the maximum output at present being 31,200 b.-hp.; (6) the general increase of the over-all efficiency of about 6 to 10 per cent; (7) the exclusive use of oil-pressure governer; (8) the efficient regulation (by means of differential surge tanks) of turbines using long pipe lines; (9) the employment of large-diameter pipe lines under high heads, resulting in an appreciable reduction of the initial cost of development. An interesting table on the water-power development in different countries of the world, as estimated in 1915, is given in this article and reproduced here.—London *Electrician*, Feb. 6, 1920.

Alabama Power Company's System, Its Development and Operation.—J. M. OLIVER, B. NIKIFOROFF and C. B. MCMANUS.—The authors set forth in a comprehensive manner many of the problems encountered in the operation of this extensive system and show the results from

CLASSIFICATION OF TROUBLES FROM JANUARY 1, 1919, TO JULY 1, 1919

	Substation		110 Kv. Lines		44-Kv. Lines		Customer	
	No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent
*Lightning	1	25	6	33	57	43.7	10	12.05
Line insulators	2	50	11	61	39	29.7	16	19.25
Conductors	..	....	..	...	6	4.55	9	10.85
Poles, guys and cross-arms	..	....	..	...	1	0.76	..	.....
†High-tension disconnecting switches	1	25	1	6	1	0.76	..	.....
High-tension oil-switch bushing	..	..	..	...	1	0.76	..	.....
Blowing of high-tension fuses	..	..	..	...	...	...	32	38.55
Transformer failures	..	....	..	...	12	9.16	6	1.20
Transformer bushing failures	..	....	..	...	8	6.05	9	7.25
Customers' equipment	..	....	..	...	1	0.76	..	10.85
Operating errors	..	....	..	...	5	3.8	..	.....
Unknown	..	....	..	...	..	....	..	.....
Total	4	100	18	100	131	100.00	83	100.00

* When line opens automatically during lightning storm and no failures are discovered.

† Switch blade dropped out while in service.

the use of relays and protective devices in establishing continuity of service. A comprehensive classification of the trouble which occurred on the system during the first six months of 1919 is given in the table.—*General Electric Review*, November, 1919.

Characteristics of Some Polyphase Transformer Connections.—L. F. BLUME and A. BOYAJIAN.—In this article may be found a brief and condensed summary of the advantages and disadvantages of practically all common schemes of polyphase connection of transformers and auto-transformers. — *General Electric Review*, December, 1919.

Traction

Remotely Controlled Electric Locomotives.—H. H. JOHNSTON.—The writer describes an installation, at a byproduct coke plant, of remotely controlled combination third-rail and storage-battery locomotives for handling coke cars while they are being loaded at the screening station. The motorman first brings the locomotive with eight empty cars and spots the first car under the loading chutes at the screening station. The motorman then throws a switch and places the locomotive under the control of the operator in the screening station and leaves the locomotive. The operator then slowly moves the train forward, stopping or reversing it as conditions may require, thereby securing an evenly and completely loaded car. When the cars are loaded the motorman returns to the locomotive and draws the cars to the classification yards, returns for empty cars and the cycle is completed. The writer then proceeds to outline the advantages of using electric locomotives and particularly those of the remote-control type.—*Electric Journal*, February, 1920.

Installations, Systems and Appliances

The Permanence of Electric Pumping in California.—CHARLES H. LEE.—When underground waters were first used for irrigation purposes some mistakes were made on account of the inability to estimate the probable water supply from this source. The writer states, however, that at the present time it is possible to study the underground water available for development in any given district. This is of importance in connection with the supply of electricity for such a load.—*Journal of Electricity*, Feb. 15, 1920.

Automatic Door Hoist for Open-Hearth Furnaces.—H. A. LEWIS and W. H. BURR.—An electric door hoist is described which is said to be simple, rugged and controlled by means of a push-button. The device is described in some detail and its advantages over hydraulic door lifts are pointed out.—*Journal Engineers' Club of Philadelphia*, February, 1920.

Units, Measurements and Instruments

Absolute Method of Determining Coefficients of Diffuse Reflection.—F. A. BENFORD.—An exceptionally accurate method is described by the author which he originated and developed to measure the coefficient of reflection of a diffusing surface. In addition to being more accurate than its predecessors, it is said to be simple, independent of the color of the standard lamp and furnishes absolute not relative values.—*General Electric Review*, January, 1920.

Electrometer Sensitivity.—E. SCHREIBER.—The influence upon sensitivity and damping of the Dolezalek electrometer of such factors as needle form and needle potential, and of certain details of construction, has been investigated by the author, who considers a sensitivity of 10^{-4} volts per millimeter a moderate value for an instrument with a one-minute period. Very much higher sensitivities may be obtained if thinner quartz fibers are used, and to decrease the period needles may be used where the middle parts are removed, leaving only an 8-shaped rim.—*Annalen der Physik*, Aug. 5, 1919.

Switchboard Meter Connections for Alternating-Current Circuits, II.—J. C. GROUP.—In this article the author takes up meter connections for two-phase, two-phase four-wire, two-phase three-wire, four-phase four-wire and four-phase five-wire circuits.—*Electric Journal*, February, 1920.

A Universal Inductance and Capacity Testing Bridge.—G. V. DRYSDALE.—The writer states that the bulk of testing methods for comparing self and mutual inductances are bridge methods in which the inductance or capacity to be tested is either connected directly in one arm of the bridge or as a shunt to one arm. To secure accuracy it is important that the circuits should be free from interference, of minimum area and symmetrically disposed, and to obtain direct reading the total

resistance of each arm of the bridge should generally be 1, 10, 100 or 1,000 ohms, etc. The bridge here described is said to fulfill these conditions and to lend itself readily to nearly every method of comparison.—*London Electrician*, Jan. 23-30, 1920.

Telegraphy, Telephony and Signals

The Telephone Receiver as a Mechanical-Electrical Transformer.—HAHNEMANN and HECHT.—The authors have recently published (*Physikalische Zeitschrift*, 1919, page 104) a theory regarding the electro-mechanical phenomena of the telephone receiver, wherein the transformations from acoustical to electrical energy and vice versa are analyzed in detail. The present paper deals with experimental results obtained during researches on the effect upon the efficiency of the receiver of external conditions, such as the surrounding air, and the adjustment of the receiver cap. In these experiments the effective resistance of the receiver was measured in a bridge at various frequencies. The efficiency of a receiver from electrical input to sound energy delivered to the ear was found to be from 1 per cent to one-tenth of 1 per cent at frequencies between 500 and 1,000 p.p.s.—*Annalen der Physik*, Nov. 20, 1919.

Structure and Operation of the Vacuum Valve.—ROBERT W. A. BREWER.—The w riter brings out some of the features upon which depend the uniformity of vacuum valves based upon extensive experiences in testing.—*Journal of Electricity*, Feb. 1, 1920.

Artificial Antennae.—K. W. WAGNER.—The electric properties of an antenna are only very roughly reproduced by an ordinary resonant circuit. Successively better approximations may be obtained by the use of networks with increasing number of elements. A single section, made up of a condenser in parallel with a branch consisting of an inductance in series with another capacity, has proved to depict very satisfactorily a homogeneous antenna for frequencies up to the fundamental frequency of the antenna. Corresponding to the three elements of this arrangement, any three conditions may be imposed upon the artificial antenna. The author studies in detail the behavior of such an artificial antenna when connected to different kinds of circuits, such as will occur in radio practice, and compares the results with those that would be obtained with an antenna having homogeneously distributed inductance and capacity.—*Archiv für Elektrotechnik*, Sept. 15, 1919.

Testing of Telephone Receivers.—PIRANI and PASCHEN.—The authors have devised a standard of sound intensity consisting of an organ pipe supplied with air under constant temperature and pressure. Telephone receivers could be compared as to efficiency by placing them in the acoustic field of the pipe and measuring the electric energy delivered by the receiver when acting as a generator. In this way results could be reproduced to $\pm$ 5%.—*Berichte der Deutschen Physikalischen Gesellschaft*, Feb. 28, 1919.

Old and New Theories Regarding Ferro-Magnetic Phenomena at High Frequencies.—H. FASSBENDER.—The older theory for explaining the apparent lowering of permeability at high frequency by hypothetical molecular viscosity has been discarded for the more modern magnetic skin-effect theory, assuming the static magnetization curve to hold even for radio frequencies. This is the conclusion reached by the author after examining in detail a great number of recent papers on the subject. μ, then, must be regarded as independent of frequency, at least down to wave lengths of a meter or two, and while the introduction of an "effective permeability" is of great help to the engineer, this quantity is usually rather vaguely defined. The author emphasizes that the so called "dynamic magnetization-curve" has no physical reality whatever, since it enters the induction in some infinitely thin layer, inside the metal as a function of the magnetic field strength at the surface.—*Jahrbuch der drahtlosen Telegraphie*, August 1919.

The Annapolis Radio Station.—A general description of the Annapolis radio station constructed by the navy and said to be the most powerful station in the United States. The high-power arc transmitter is of the Poulsen type, and the general equipment required is as follows: A source of direct current, an arc converter, an antenna loading inductor, an antenna and ground system, a signaling device and auxiliary and control apparatus.—*Wireless Age*, December, 1919.

A Method of Finding the Tension of Wires Without Tension Ratchets.—Curves have been worked out for obtaining the proper tension in small telephone and telegraph wires during stringing. In this method the linemen strike the wire and count the number of reflections which pass over the wire and return in a given time.—*Post Office Electrical Engineers' Journal* (London), January, 1920.

Miscellaneous

Harmonic Analysis.—R. SLABY.—The author shows that owing to certain properties of the Fourier series the amplitude of any harmonic component in an alternating-current wave may be determined in the following way: To determine the kth amplitude in the sine series of the periodic curve, form the difference between the squares of the r.m.s. values of the given curve and of a new curve which is derived by adding to the first one the function $h \sin k\omega t$. This difference is equal to the kth amplitude plus $h/2$. Cosine terms are obtained in a similar way. If the curves are plotted in polar co-ordinates, the r.m.s. values may be obtained from the inclosed area, as measured by planimeter. For the fundamental $h \sin k\omega t$ ($k=1$) in polar representation is a circle and the construction is particularly simple. Also, in case of the higher harmonics, the analysis may be much simplified if certain special polar co-ordinates, so called wave co-ordinates, are employed.—*Elektrotechnische Zeitschrift*, Oct. 23 and 30, 1919.

The Thermal Conductivity of Solid Insulators.—W. M. THORNTON.—Data are given for the thermal conductivity of quartz, flint glass, graphite, marble, paraffin wax and other insulating materials.—*Philosophical Magazine*, December, 1919.

Effect of Line Resistances Upon Short-Circuit Phenomena in Synchronous Machines. — BIERMANNS. — When a short-circuit takes place there is often a considerable resistance in the line from the machine to the point where the fault occurs. The author studies analytically the effect of such line resistance upon the short-circuit phenomena in synchronous generators and also discusses the effect of a ground upon a system to which several generators are connected in parallel.—*Archiv für Elektrotechnik*, Nov. 10, 1919.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

Water-Power Conference Again Postponed

FURTHER consideration of the water-power bill by conferees of the Senate and House, which was to have taken place this week, has again been postponed. The conferees have decided to put off the meeting until next week owing to the pressure of other legislation.

It was some time after the passage of the Senate bill before the conferees first met because of the railroad bill conference, and then there was almost immediately further adjournment out of respect to Senator Bankhead, who had just died. The conferees met a week later and adjourned on March 9, without coming to an agreement, after a two-day conference. At this time there were only two major points of difference between the conferees. No meeting has since been held.

Nation in Throes of Local Daylight-Saving Decision

ALTHOUGH Congress did not favor the continuance this year of the daylight-saving plan which was adopted for two years as a war measure, a number of states and communities have signified their intention of turning the clock ahead an hour this Sunday. Other places have similar measures under consideration.

An attempt this week to repeal the New York State daylight-saving ordinance failed. New Jersey has such a law now before the State Legislature. There is no state law in Pennsylvania, but a number of cities have such an ordinance. Both Philadelphia and Meadville, Pa., repealed the local ordinance this week.

The daylight-saving act has passed the Massachusetts House and is now before the Senate. Local daylight saving is effective in Hartford, Conn., next Monday and is expected to spread co-operatively through Connecticut. Worcester, Lynn, Clinton and Marlboro, all in Massachusetts, have also adopted the plan. The Maine Legislature killed the act. New Hampshire and Vermont are hostile and Rhode Island is lukewarm.

Daylight saving is being re-established this year in many cities and towns of the Central States, and public sentiment seems to be generally in favor of the plan. The majority that have made the change have adopted a seven-month period, dating from the last Sunday in March to the last Sunday in October, though some prefer the five-month period from the last Sunday in April to the last Sunday in September. Cleveland, Detroit, Cincinnati and Denver are among the cities which will change over for seven months, while Columbus, Ohio, has decided upon the five-month plan. Chicago is expected to line up with Columbus when the City Council meets on Monday. The people of Minneapolis voted in favor of daylight saving.

Georgia has a state law placing the time for the entire state on the basis of eastern time. Atlanta, however, follows central time schedule. This law serves to put many Georgia cities on a daylight-saving basis.

No daylight-saving plans are contemplated on the Pacific Coast so far as can be learned. Local daylight-saving ordinances were overwhelmingly defeated in both Oakland and San Francisco, Cal., recently, although a petition from citizens is again before the San Francisco supervisors.

Many Projects Contemplated for Pacific Coast

A NUMBER of construction projects for the Pacific Coast are announced this week. A permit has been filed with the State Engineer of Oregon for appropriation of 200 second-feet to develop 26,000 kw. for irrigation in Harney Valley and to serve municipalities including the city of Vale. The Pacific Gas & Electric Company is to install during the current year two 12,000 kw. turbines on the Pit River and one 12,500-kw. steam turbine in Oakland, and to make additions to the Sierra San Francisco Light & Power Company's properties to produce 16,000 kw., additional power. The Sespe Light & Power Company of Ojai, Cal., is installing a power plant on the Sespe River and will issue bonds and capital stock for $1,000,000 to construct four dams, three ditch systems and three power houses. A hydro-electric plant is proposed for Paradise Creek, Rainier National Park, near Tacoma, to supply hotels with heat, light and power. Roseburg, Ore., is to vote on a $500,000 bond issue.

I. E. C. Meetings Being Held This Week in Belgium

MEETINGS of the advisory committees of the International Electrotechnical Commission on nomenclature, rating of electrical machinery, symbols and standard pressures will be held in Brussels, Belgium, commencing Saturday of this week. The Belgian electrotechnical committee has been actively engaged in completing the details for the meeting, and although a very busy time is before the delegates, the Belgians, General Societary C. le Maistre informs the ELECTRICAL WORLD, have been desirous of arranging for one or two excursions for the benefit of the visiting delegates.

The decisions arrived at at these meetings will ultimately be placed before all the national committees with a view to their adoption at the next plenary meeting, which is expected to be held later in the year. Dr. C. O. Mailloux, president of the commission, left for Belgium some time ago. The other American delegates nominated by the United States national committee to attend these meetings are Dr. Agnew, H. M. Hobart, A. H. Moore, L. W. Chubb and C. E. Skinner.

News in Brief

SUMMARY

of Important Happenings in the Industry During the Week

DEMAND for electrical supplies is not quite up to that experienced by the trade in the latter months of 1919. The shortage of many materials is holding back some business, but few jobs, it appears from reports, are really suffering because there is no equipment to complete them. The delivery situation has bettered to some degree, but is very far from satisfactory. Small shipments are coming in, but in many cases they are shipments that have been since January and February in transit.

FIBER-CONDUIT sales are good and mills are well booked up. The fan outlook is better than ever before at this time of year, and orders are coming in up to four times those of other years. A special shortage is noted in magnet wires because of the dearth of long-fiber cotton and the heavy demand.

MUCH confusion over daylight-saving projects exists in various sections of the country, indicating the adoption of widely varying programs.

MANY new construction projects are announced by electric power companies on the Pacific Coast.

BETTER public relations were urged by the speakers at the convention of the Wisconsin Electrical Association on Wednesday and Thursday.

FURTHER postponement until next week of consideration of the water-power bill by the Congressional conference committee has been made.

THE TENTATIVE program of the Pasadena convention of the N. E. L. A., to be held from May 19 to May 21, has been issued.

EIGHT per cent as a limitation of return is seriously handicapping the electrical industry, in the opinion of George N. Tidd, vice-president American Gas & Electric Company, as expressed in the ELECTRICAL WORLD.

CO-ORDINATED effort as the great need of electrical manufacturers was strongly advocated at the annual meeting of the Associated Manufacturers of Electrical Supplies. J. F. Kerlin was elected president of the association for the ensuing year.

PRESIDENT WILSON'S Industrial Conference in its final report outlines a plan for settling trade disputes which it has extended to cover public utilities.

THE MERGER of Westinghouse, Church, Kerr & Company and Dwight P. Robinson & Company has been declared operative.

CONSOLIDATION of the construction and engineering departments of the Postal Telegraph-Cable Company into the plant and engineering department has taken place.

POWER-FACTOR correction and outdoor substations were discussed at an open meeting of the transmission and distribution committee of the Ohio Electric Light Association at Canton.

BY A DECISION of the Appellate Division of the Supreme Court of New York the New York Edison Company is sustained and the Public Service Commission overruled in the case arising out of the Edison company's refusal to furnish break-down service to a firm owning a private plant and desiring to supplement its supply to outside consumers in this way.

GENERAL GEORGE H. HARRIES has been nominated as president of the Illuminating Engineering Society.

THE DISPUTE between the Hiawassee Power Company and the Carolina-Tennessee Power Company will not be adjudicated by the United States Supreme Court, which disclaims jurisdiction.

ARGUMENT has been had before the United States Supreme Court in the suit of the Kansas City Bolt & Nut Company charging breach of contract against the Kansas City Light & Power Company.

INCREASED production is to be the keynote at the convention of the Chamber of Commerce of the United States to be held at Atlantic City, N. J., April 27 to April 29.

WHITE SULPHUR SPRINGS, W. Va., has been selected by the Conference Club as the place for its next meeting to be held in June or July. A committee of three will represent the club at the Pasadena convention of the N. E. L. A.

A MEASURE passed by the State Legislature of Ohio permits municipalities to assess all or part of the costs of "white way" lighting on the owners of abutting property.

ELECTRIC UTILITIES as investments are coming into public favor according to a Stone & Webster report issued this month.

A SURVEY of residential lighting in Chicago is being made with the object of improving the standard of lamps and fixtures.

UNDER the provisions of the naval appropriation bill as reported to the House of Representatives, $28,000,000 is provided for the new Bureau of Engineering, which will have charge of the navy's electrical work as well as of engineering operations of other kinds.

CONSTRUCTION of two 140,000-volt transmission lines 70 miles in length is part of a development program adopted by the Consumers' Power Company of Michigan.

SAMUEL GOMPERS declares that union labor should work for government ownership and operation of water powers and for close government control over utilities and corporations.

EXCLUDING war purchases by the Federal Government, the sales of the Western Electric Company for 1919 were $6,000,000 in excess of those for 1918.

GOVERNMENT control of coal prices will end on April 1. Bituminous coal miners are to have a wage increase on a 27 per cent basis.

ALL BRANCHES of the industry were represented at the question box conference of the New England section, N. E. L. A., in Boston, March 18, and active steps toward increased co-operation were evident.

AN EXTENSION of its boiler plant to cost nearly $750,000 will be made by the Narragansett Electric Lighting Company, Providence, R. I.

MEETINGS of the advisory committees of the International Electrotechnical Commission begin in Brussels, Belgium, today.

CONSTRUCTION work of a noteworthy kind has been begun by the Central Illinois Public Service Company.

FINAL plans have been made for the joint meeting in Boston on April 9 and 10 of the A. I. E. E. and the American Electrochemical Society and for participation by the Electric Furnace Association, which is also to hold a meeting at that time.

Better Public Relations Theme of Wisconsin Convention

NEARLY every speaker who addressed the opening sessions of the twelfth annual convention of the Wisconsin Electrical Association held Wednesday and Thursday at Milwaukee emphasized the necessity for better public feeling toward utilities and toward the regulating commissions. Confidence was expressed in the public's sense of justice when properly informed. It was said to be the utility manager's duty to show the masses that utilities are entitled to a higher place in the public esteem and to greater returns on their investments.

"Central stations are selling their service for much less than it is worth. Great as are the utility problems in this and other respects, they are not too difficult to be solved," said W. S. Lounsbury in his presidential address. His admonition to the members of the association was to "study the past while trying to follow every new path, hold fast to things which are fundamentally right, have faith, inspire public confidence in business and a spirit of loyalty to the company among your employees."

B. J. Mullaney of the People's Gas Light Company, Chicago, who substituted for M. E. Sampsell, president of the Wisconsin Power, Light and Heat Company, recommended that the Wisconsin utilities establish a committee for the dissemination of public utility information to newspapers and others as is done in Illinois, Indiana and elsewhere. The speaker said:

"For the expenditure of about one-fiftieth of 1 per cent of the companies' gross revenues gratifying results could be obtained. The Illinois committees' prepared articles were given 14,000 column inches in the principal papers in the state and this publicity was obtained without arousing any hostility or unfriendly comment and has had a very favorable effect on the attitude of the newspapers toward all public utilities."

M. H. Aylesworth, executive manager of the National Electric Light Association, in an address on public policy said that if the public utilities will tell the public what they need they can get it. "The public has found out that central stations and other utilities are not profiteers," said Mr. Aylesworth, "but the companies have not yet taken the people sufficiently into their confidence to make the masses realize that public utilities, instead of being heartless corporations, are true friends of mankind."

Program of Boston Joint Electrochemical Meeting

FOR the joint meeting in Boston April 9 and 10 of the American Institute of Electrical Engineers and the American Electrochemical Society, in which the Electric Furnace Association will also participate, the following program has been scheduled:

Friday Morning, April 9.—W. D. Bancroft presiding. Symposium on "Electrically Produced Alloys": H. E. Howe, "Fundamental Problems in Alloys Research"; R. J. Anderson, "Recent Developments in the Ferro Alloy Industry"; C. B. Gibson, "The Manufacture of Ferro Alloys in the Electric Furnace"; B. D. Saklatwalla, "Ferro-Vanadium"; Ellwood Haynes, "Stellite"; F. A. Raven, "Properties of Ferro-Silicon"; E. S. Bardwell, "Ferro-Manganese"; R. C. McKenna, "The Manufacture of High-Speed Steel in the Electric Furnace"; Alcan Hirsch, "Ferro-Cerium"; Theodore Swann, "Ferro-Zirconium"; B. G. Klugh, "Ferro-Phosphorus"; R. M. Major, "Nichrome and Other Special Alloys"; T. D. Yensen, "Electric Properties of Nickel-Iron Alloys"; M. A. Hunter, "Electrical Properties of Titanium Alloys"; C. F. Harding, "Nitrogen Fixation by the Silent Discharge."

Friday Evening, April 9.—President Townley of the A. I. E. E. presiding. Symposium on "Power for Electrochemical Industries": John L. Harper, "Power for Electrochemical Plants"; John A. Seede, "Automatic Control of Arc-Furnace Electrodes"; H. A. Winne, "Reactors for Electric Furnace Circuits"; C. A. Winder, "Economies of the Power Situation"; E. A. Wilcox, "Electric Furnace Power from the Standpoint of the Central Station"; H. L. Hess, "The Electric Furnace and the Central Station"; C. T. Maynard, "Location of a New England Electrochemical Plant"; F. F. Fowler, "Water Powers of the Pacific Coast"; J. W. Beckman, "Power Development in Scandinavia"; W. G. Berlin, "Power Problems from the Standpoint of the Furnace Operator."

Saturday Morning, April 10.—J. W. Richards, "The Soderberg Self-Baking Continuous Electrode"; Charles A. Jeller, "Synthetic Electric Furnace Pig Iron"; Philip B. Short, "Step Induction Regulators for Electric Furnaces"; Clarence J. West, "The Electric Furnace as Applied to Metallurgy"; H. M. St. John, "The Electric Brass Furnace, Its Evolution"; L. B. Lindemuth, "The Electric Furnace in Iron and Steel Metallurgy"; Edward F. Kern, "Reduction of Maganiferous Silicate Slags."

The delegates will visit the Lynn Works of the General Electric Company Friday afternoon and the Huff Electrostatic Separator Company Saturday afternoon.

An informal subscription dinner will be held Friday evening at the Copley-Plaza Hotel.

Pacific Coast N. E. L. A. Section Program

JUST prior to the N. E. L. A. Pasadena Convention the Pacific Coast Section will hold a two-day convention at the same place on May 17 and 18. All sessions will be joint meetings of the engineering, commercial, accounting and publicity sessions. A special report on the California Electrical Co-operative Company will be made by L. H. Newbert.

The program of papers follows:

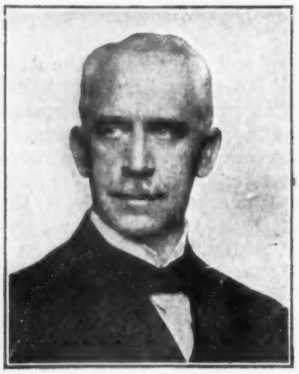
Engineering Committee—"Railway Electrification," by J. E. Woodbridge; "Method of Improving Power Factor, and Suitable Rates," by E. A. Quinn; "Use of Maximum Rated Motors as Affecting Central Stations and Consumers," by John Hood; "Electric Furnaces," by J. A. Koontz and W. M. Shepard; "Economic Use of Galvanized Steel Wire," by J. P. Jollyman and J. F. Strachan; "Progress Report on Insulator Investigations," by J. A. Koontz; "Relay Protective Systems," by G. E. Armstrong; "Automatic Protection of Small Motors," by G. E. Armstrong; "Use of Variable Speed A.C. Motors vs. D.C. Motors for Elevator Service," by S. J. Lisberger.

Accounting Committee—"Construction Accounting," by C. P. Staal; "Standardization of Titles," by A. B. Carpenter and R. R. Reidford.

Commercial Committee—"How the Electrical Industry Should Co-operate with the Architect and Builder," by Garnett Young; "The Value of Proper Illumination," by F. D. Fagan; "Commercial Aspects of Railway Electrification," by E. B. Criddle, W. L. Frost and G. B. Kirken; "Commercial Aspects of Storage of Water at Higher Elevations," by E. B. Walthal, D. R. Kenney and E. J. Crawford; "Central Station Power versus Internal Combustion Engines," by R. E. Fisher; "Standardization of Wiring Devices, Terminals and Budgets," by H. H. Courtright; "Electrical Development of Oil Lands," by R. A. Balzari; "Value of Solicitors," by A. W. Childs; "Statistics Regarding Unelectrified Horsepower," by J. O. Case.

Publicity Committee—"Report of Activities," by L. W. Alexander.

General Harries Nominated for President of the I. E. S.



GEN. GEORGE H. HARRIES

AT THE recent meeting of the council of the Illuminating Engineering Society the report of the nominating committee was accepted. The following nominations were unanimously made by the committee: For president, Gen. George H. Harries; secretary, Clarence L. Law; treasurer, Louis B. Mark; vice-presidents: New England Section, H. F. Wallace; Philadelphia Section, G. S. Crampton; Chicago Section, J. J. Kirk; directors, Adolph Hertz, Walton Forstall and Frank S. Price.

Conference Club Decides to Meet at White Sulphur Springs

INSTEAD of holding its next meeting in California in conjunction with the N. E. L. A. convention and the jobbers' meeting, the Conference Club has decided to hold its next meeting between June 10 and July 10 at White Sulphur Springs, W. Va., and to send to the California conventions a committee of three composed of L. K. Comstock, W. C. Peet and Sullivan Jones. This decision, together with the election of new members, was the principal item of business at the meeting of the club held at Cleveland on March 18.

The decision as to the time and place of the next meeting came as the result of a feeling on the part of some members that the club would not be prepared for a meeting at the time of the California meetings. As a result of the balloting invitations are about to be sent to twenty-two proposed members, representing the different branches of the industry.

As soon as the men signify their intention in regard to membership in the club, the committee on bylaws and constitution will be appointed and asked to prepare a report for the next meeting. Members of this committee will represent all branches of the industry.

Coal Miners' Wages to Go Up 27 Per Cent

NO GOVERNMENT price-fixing control of coal will be exercised after April 1, President Wilson announced on Tuesday in making public the report of the bituminous coal commission. The commission awarded the miners a wage increase which is on a 27 per cent basis, the 14 per cent increase of last October to come to an end March 31. The new wage scale goes into effect April 1 and continues for two years. In this way the wage contract is terminated in the spring rather than the fall.

In addition to the award, the majority report made recommendations looking to the storage of a minimum of three months' winter supply of bituminous coal by July 1 of each year by federal government departments, public utilities, railroads and domestic consumers; the study of the Interstate Commerce Commission of the advisability of instituting freight rates on coal lower in the spring than in the fall and winter months, and that steps be taken to minimize as far as possible car shortages in the transportation of coal.

National Electrical Code Changes Under Consideration

FINAL recommendations for the 1920 National Electrical Code were received at an open meeting of the electrical committee of the National Fire Protection Association on March 23. These recommendations did not advocate any radical differences from the changes recently proposed by the committees of the association as outlined in the ELECTRICAL WORLD of Feb. 14, 1920.

After this public meeting the committees again went into session to adopt the final revision of the rules. This work was not completed at the time of going to press, but it is understood that the final changes will be incorporated within a short time.

Program of N. E. L. A. Pasadena Convention

A TENTATIVE draft of the program of the National Electric Light Association convention at Pasadena, Cal., in May has just been made public. Matters of broad, major importance will be presented in the general or morning sessions, while the more specialized subjects will be considered in detail at the afternoon sessions of the four national sections.

Following the president's reception on Tuesday evening, May 18, the convention will open Wednesday morning at 9:30. There will be four general sessions, on Wednesday, Thursday, Friday and Saturday mornings. The Wednesday morning session will be convened at 9:30, and each of the other sessions will be called to order promptly at 9 a.m. and adjourned about 1 p.m.

On the afternoons of these four days, excluding Saturday, there will be held eight sessions of the four national sections—Accounting, two sessions; Commercial, three sessions; Electric Vehicle, one session, and Technical and Hydro-Electric, two sessions. These sessions, some of which will be run in parallel, will be called to order at 2:30 p. m. and adjourned about 5:30 p. m.

The public policy session will be held Thursday evening.

This year, owing to distances from electrical manufacturing centers, difficulties of transportation, supply and demand conditions and lack of suitable space, the customary exhibition is omitted. However, there will be an unusually interesting and important exhibition and demonstration of industrial lighting equipment and its application, under the auspices of the lighting sales bureau, Commercial Section, in connection with the report of its industrial lighting division.

In addition to a large number of opportunities for entertainments, there will be a California mission play staged on Wednesday night, May 19, and Friday night will be given over to a monster entertainment, tendered by the Pacific Coast Section.

N. E. L. A. Pasadena Convention Program

(Tentative Draft Subject to Revision)

General Sessions

WEDNESDAY, MAY 19, 9:30 A. M.

1—Welcome to California, Gov. William D. Stephens.
2—Address of President Ballard.
3—Appointment of committee on president's address.
4—Report of Executive Manager Aylesworth.
5—Announcements.
6—Report of committee of water-power development, Franklin T. Griffith.
7—Report of committee on rate research, Alex Dow.
8—Report of committee on lamps, Frank W. Smith.
9—Report of insurance expert, W. H. Blood, Jr.
10—Address of chairman Commercial Section, John G. Learned.
11—Report of Merchandise Sales Bureau on electric ranges, J. Paul Clayton.

THURSDAY, MAY 20, 9 A. M.

1—Report of committee on company sections, F. A. Birch.
2—Report of committee on geographic sections, R. J. McClelland.
3—Address (speaker and subject to be announced by Lighting Sales Bureau).
4—Report of committee on commercial service and relations with customers, R. F. Bonsall.
5—Election of nominating committee.
6—Report of committee on constitution and bylaws, W. C. L. Eglin.
7—Appointment of committee on memorials.
8—Appointment of committee on resolutions.
9—Report of Bureau of Advertising and Publicity Service, L. D. Gibbs.
10—Paper: "Committee Service," S. M. Kennedy.
11—Report of committee on membership, Walter Neumuller.
12—Report of Treasurer Abell.
13—Address (title to be announced), E. O. Edgerton, president California Railroad Commission.

FRIDAY, MAY 21, 9 A. M.

1—Address, R. W. Symes, chairman Accounting Section.
2—Report of committee on education, Fred R. Jenkins.
3—Report of committee on accounting education, Douglass Burnett.
4—Report of committee on relations with educational institutions, John F. Gilchrist.
5—Report of committee on accident prevention, Charles B. Scott.
6—Report of committee on safety rules, W. C. L. Eglin.
7—Address, I. E. Moultrop, chairman Technical and Hydro-electric Section.
8—Report of committee on inductive interference, A. E. Silver.
9—Report of committee on electrification of steam railroads, Frank M. Kerr.
10—Address (speaker and subject to be announced by Power Sales Bureau).
11—Paper: "Trend of Regulation," Carl D. Jackson, chairman Wisconsin Railroad Commission.
12—Report of committee on electrical resources of the nation, M. S. Sloan.

SATURDAY, MAY 22, 9 A. M.

1—Address, George B. Foster, chairman Electric Vehicle Section.
2—Paper: "Electric Machinery for All Handling—An Opportunity," Zenas W. Carter.
3—Report of committee on public information, John F. Gilchrist.
4—Report of committee on bonus systems, Harry A. Snow.
5—Report of committee on insurance, E. J. Fowler.
6—Report of committee on co-operation in the industry, Lee H. Newbert.
7—Address: "The Society for Electrical Development," J. M. Wakeman.
8—Report of committee on sale of company securities to customers and resident citizens, George R. Jones.
9—Report of committee on Doherty and Billings prizes, A. S. Loizeaux.
10—Report of committee on president's address.
11—Report of committee on constitutional amendments.
12—Report of committee on memorials.
13—Report of committee on resolutions.
14—Report of committee on nominating.
15—Election and installation of officers.

Technical and Hydro-Electric Sessions

WEDNESDAY, MAY 19, 2:30 P. M.

1—Chairman's address, I. E. Moultrop.
2—Appointment of nominating committee.
3—Announcements.
4—Report of committee on meters, F. V. Magalhaes.
5—Report of committee on prime movers, N. A. Carle.

THURSDAY, MAY 20, 2:30 P. M.

1—Election of officers and executive committee.
2—Report of committee on overhead systems, W. K. Vanderpoel.
3—Report of committee on underground systems, F. E. Ricketts.
4—Report of committee on electrical apparatus, R. F. Schuchardt.

Commercial Sessions

WEDNESDAY, MAY 19, 2:30 P. M.

1—Chairman's address, John G. Learned.
2—Report of committee on finance, M. S. Seelman.
3—Appointment of nominating committee.
4—Report of committee on constitutional amendments, R. H. Tillman.
5—Report of committee on wiring, R. S. Hale.
6—Report of Merchandise Sales Bureau, E. A. Edkins.
7—Report of electrical merchandise division, F. D. Pembleton.
8—Report of division on electric shop management, C. E. Greenwood.
9—Report of division on standardization and testing, O. R. Hogue.
10—Report of division on electric ranges, J. Paul Clayton. (Discussion continued from general session, Wednesday morning.)

THURSDAY, MAY 20, 2:30 P. M.

1—Report of committee on "Electrical Salesman's Handbook," I. Lundgaard.
2—Report of division on economics of the use of central-station electric power (Power Sales Bureau), John W. Meyer.
3—Report of division on electrochemical processes (Power Sales Bureau), C. H. McClure.
4—Report of division on industrial electric heating (Power Sales Bureau), N. T. Wilcox.
5—Report of Bureau of Lighting Sales, Clarence L. Law.
6—Report of division on street and highway lighting, W. T. Dempsey.
7—Report of division on residence lighting, M. Luckiesh.
8—Report of division on lighting of large buildings, G. Bertram Regar.
9—Report of division on store lighting, F. C. Taylor.
10—Report of division on commercial aspects of lamp equipment, George H. Stickney.
11—Discussion of preceding Lighting Sales Bureau reports.
12—Report of division on industrial lighting. H. H. Magdsick. (In form of demonstration.)

FRIDAY, MAY 21, 2:30 P. M.

1—Report of committee on compensation of salesmen, Adolph Hertz.
2—Election of officers and executive committee.
3—Report of division on electric steel furnaces (Power Sales Bureau), Joseph McKinley.
4—Report of division on general power (Power Sales Bureau), W. E. Murphy. (This report will consist of a paper by W. G. Taylor, General Electric Company, entitled "Electric Power in the Oil Fields.")
5—Report of division on power contract (Power Sales Bureau), R. H. Ashworth. (This report will consist of a paper, presented by the chairman, entitled, "Standardization of Power-Factor Specifications in Power Contract on the Part of Central-Station Companies.")
6—Report of division on isolated plants (Power Sales Bureau). J. B. Stuart.
7—Report of division on electric development (Power Sales Bureau). Morse DellPlain.

Accounting Sessions

THURSDAY, MAY 20, 2:30 P. M.

1—Chairman's address, R. W. Symes.
2—Appointment of nominating committee.
3—Report of committee on credits and collections, David Darlington.
4—Report of committee on classification of accounts and accounting relations with other associations, William Schmidt, Jr.
5—Report of committee on form of annual reports to commissions, W. J. Meyers.
6—Report of committee on merchandising accounting, C. W. Johnson.
7—Report of committee on accounting service to member companies and the Monthly Bulletin, Frederick Smith and L. A. Coleman.
8—Report of committee on motor-vehicle records, G. P. Landwehr.

FRIDAY, MAY 21, 2:30 P. M.

1—Report of committee on purchasing and storeroom accounting, W. F. Stevens.
2—Report of committee on federal income tax procedure, H. E. Addenbrooke.
3—Report of committee on customers' records and billing methods, J. D. Jacobus.
4—Report of nominating committee on section officers.
5—Election of officers and executive committee.

Electric Vehicle Session

FRIDAY, MAY 21, 2:30 P. M.

1—Chairman's address, George B. Foster.
2—Appointment of nominating committee.
3—Report of committee on legislation, G. A. Freeman.
4—Report of committee on standardization, E. R. Whitney.
5—Paper: "The Uses and Abuses of Electric Vehicles," H. J. Butler and W. J. Burns.
6—Report of committee on electric vehicle and Power Sales Bureau co-operation, E. S. Mansfield.
7—Report of committee on garage and rates, Willis M. Thayer.
8—Report of committee on federal and municipal transportation, James H. McGraw.
9—Report of committee on transportation engineering, F. M. Feiker.
10—Election of officers and executive committee.

Gompers for Government Ownership of Water Powers and Utilities

THAT public and semi-public utilities shall be "owned, operated or regulated by the government in the interests of the people"; that the federal and state governments should "own, develop and operate all water power over which they have jurisdiction, power thus generated to be supplied to all citizens at rates based upon costs," and that there should be legislation for federal licensing of all corporations organized for profit, federal supervision and control over the increasing of capital stock and the incurring of bonded indebtedness, with the provision that all books of corporations shall be open at all times to federal examiners, are three among many radical planks favored by Samuel Gompers, president of the American Federation of Labor, in outlining union labor's political program in the current issue of the federation's organ.

Eight Per Cent Return Insufficient, Declares George N. Tidd

THAT the limitation by public service commissions of the return on invested capital to about 8 per cent is seriously handicapping the development of electric utilities is the opinion of George N. Tidd, vice-president of the American Gas & Electric Company, as expressed in a statement to a representative of the ELECTRICAL WORLD. Mr. Tidd said that additions and improvements to plants are now made only where most urgently required, and that while his company has an extensive construction program mapped out, it does not feel justified in going ahead with it when capital costs 9 per cent and the return allowed is but 8 per cent. There is now a greater demand for central-station energy than ever before, and this demand is coming from large manufacturers who are making extensions to their factories or wish to abandon their own power plants because central-station energy has been found cheaper and more satisfactory.

"We must meet this demand on the old basis of 8 per cent return," said Mr. Tidd, "while no such limitation is placed on the manufacturers. The commissions, in establishing a schedule of rates based on an 8 per cent return, have overlooked the fact that there are two classes of customers who purchase energy from utilities—first, those who must have the service, such as residences, commercial and small power users; second, large users of power who purchase energy only when to do so is cheaper than to develop it themselves. The latter is really a competitive proposition, and for this class of business electric companies should be allowed to adjust their rates to cover all items of interest, depreciation, obsolescence and operating costs. They would then bid for this business at a rate which would earn an adequate return on investment and yet, being competitive, would have to be low enough to show a satisfactory saving against a privately operated power plant."

Restricting electric utilities to an 8 per cent return, according to Mr. Tidd, has the effect of penalizing development, because, no matter what degree of economy is reached in operation, the ratio of net earnings to invested capital must remain the same. The company that has a high operating efficiency, he pointed out, is not permitted any higher reward in the rate of return than is the less efficient company.

"There is a growing sentiment in favor of the electric utilities and the high peak in operating costs has been passed," Mr. Tidd said, "but the electric utilities are in a position similar to the railroads of the country. They have passed through a strenuous period when construction was curtailed or discontinued entirely, and now, in order to give the high class of service demanded by the public, they must be permitted to earn a sufficiently high return on the investment to attract the necessary capital for their development."

Western Electric 1919 Sales Below War Period

FOUNDED in 1869, the Western Electric Company points, through President Charles G. Du Bois's annual report to stockholders, just issued, to total sales for its semi-centennial year of $135,722,000. This is an increase for 1919 as compared with 1918 of more than $6,000,000 in normal business, although a decrease of $16,000,000 in war emergency purchases by the United States Government makes the total fall $9,500,000 below the total figures for 1918. The year 1917, with $150,000,000 in aggregate sales, was also a war year. In 1916 the total was less than $107,000,000, and in 1915 it was only $63,852,000, or less than half last year's business, exclusive of government purchases.

The net earnings of the company for 1919 were $5,652,089, or 6.9 per cent on the average investment for the year, which was $81,400,000. The manufacture of telephone equipment constitutes more than 50 per cent of the company's business.

The unfilled orders of the company on Dec. 31 aggregated $47,442,000, which is the largest amount of business ever on the books and compares with $26,265,000 at the end of 1918.

No earnings from foreign business are included in the figures for 1919, but it is asserted that the International Western Electric Company owns interests ranging from 10 to 100 per cent in companies established in England, France, Belgium, Norway, Switzerland, Austria, Hungary, Russia, Italy, Australia, South Africa, Canada, Argentina, China and Japan.

Ohio Steel Mills Increase Central-Station Load Tenfold

STEEL mills operating in the territory served by the Trumbull Public Service Company of Warren, Ohio, have so enlarged their demands for energy that the peak load and kilowatt-hour output of that company are ten times what they were at the beginning of 1914. Starting with a generating capacity in 1914 of 4,400 kw. on which the peak load was 2,100 kw., the capacity, demand and kilowatt-hour output have now grown to ten times their sizes at that time. This is best shown by the following tabulation:

Year	Generating Capacity, Kw.	Peak Load, Kw.	Annual Output, Kw.-hr.
1913	4,400	2,100	7,047,174
1914	4,400	2,260	7,170,463
1915	8,750	3,836	11,842,401
1916	8,750	5,705	16,592,121
1917	8,750	7,155	26,828,267
1918	24,150	17,000	53,566,660
1919	36,650	21,220	69,208,946

At the present time the peak load on this plant is 24,000 kw. and the monthly output upward of 7,000,000 kw.-hr. It has been impossible, M. R. Bump, chief

engineer of the Cities Service Company, stated to a representative of the ELECTRICAL WORLD, for the company to add generating capacity to keep pace with the demands of the steel mills in the territory. A 12,500-kva. turbo-generator is now being installed but will not be sufficient to take care of the additional load. He further said that were it possible to install the generating capacity to supply as much energy as has been requested by the steel mills, the present kilowatt-hour output of the Trumbull Public Service Company would be doubled. With the addition of the new 12,500 kva. unit the annual output for 1920 is expected to reach 100,000,000 kw.-hr.

Residential Lighting Survey Being Made

BAD as are illuminating conditions in Chicago factories, they are much worse in the city's homes if the preliminary figures of a survey now being made are a fair criterion, said W. A. Durgin of the Commonwealth Edison Company in a paper read before the Chicago Section of the Illuminating Engineering Society on March 17. Cheapness and artistic design seem to determine the choice of fixtures to the practical exclusion of engineering considerations. Fixture manufacturers can help to improve the standard of illumination in new residences, Mr. Durgin said, but the lamp and glassware men must be depended upon to help raise the standard in old homes.

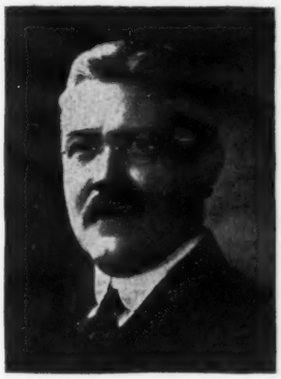
A paper was presented by M. Uchisaka, illuminating engineer of the Tokyo (Japan) Electric Company, on the fixtures used in Japan.

Industrial Conference Outlines New Plan for Collective Bargaining in Utilities

JOINT organization of management and employees as a means of preventing misunderstandings and furthering co-operative effort—in other words, the shop council—is recommended in the final report, issued this week, of the Industrial Conference appointed by President Wilson. The conference has extended its proposed method of settling trade troubles to cover disputes affecting public utilities other than steam railroads. The report asserts that, as modified, the plan makes machinery available for collective bargaining with only incidental and non-compulsory arbitration. It involves no penalties other than those imposed by public opinion, does not deny the right to strike and does not submit to arbitrators the policy of the "closed" or "open" shop.

The method of adjusting disputes advocated by the conference involves the creation of regional adjustment conferences, which in the case of public utilities shall consist of a federal official as chairman, four representatives of the parties to the dispute, two from each side; one employer representative and one employee representative taken from a panel already formed in the class of public utility in which the dispute arises, and two members representing the government authority which has power to regulate the service of the public utility. In case of failure of the chairman to obtain the creation of a regional adjustment conference, he shall proceed to form a regional board of inquiry of similar composition, the members for any side refusing to join in the conference being selected from the panel already mentioned. Should an agreement be reached by the conference or the board of inquiry, this will constitute a collective bargain. Should agreement fail, the case is to be carried to a national industrial board of nine members appointed by the President and confirmed by the Senate, whose decision, if accepted by the parties to the dispute, shall also constitute a trade agreement. During these processes of adjudication no interruption of work must take place.

Manufacturers See Need for Co-ordinated Effort



J. F. KERLIN

THAT co-ordinated effort is more necessary now than ever before was voiced almost as the keynote of the fourth annual meeting of the Associated Manufacturers of Electrical Supplies, held in New York on March 18, by A. W. Berresford in his presidential address. The meeting came in a week full of activity in the various section meetings. A banquet was held at the Waldorf-Astoria Thursday evening, at which Dr. W. R. Whiting spoke on "Research" and F. R. G. Gordon of the National Electric Light Association on "Vital Questions of the Day." Edward J. Cattell of Philadelphia was also one of the speakers.

In opening the afternoon session Mr. Berresford, after speaking of the accomplishments of the association, emphasized the necessity for organization. Charles E. Dustin, general secretary, in a brief report laid particular emphasis on the formation of the general standards committee. (Reported in the ELECTRICAL WORLD for March 6.)

Judge Thomas M. Debevoise, counsel for the association, cautioned the membership not to hew too close to the line and stated that the board of governors had appointed a committee to investigate the work of the sections in order to find some program for widening the work of the association.

A full report of the activities of the international trade committee, of which John J. Gibson, Westinghouse Electric & Manufacturing Company, is chairman, made it clear that a better response to the committee's questions must be made by the manufacturers. If the information is not received through this committee, the Tariff Commission will take steps to procure it by law.

After other reports were received the program for the League for Industrial Rights was explained by its counsel, Mr. Merritt.

A resolution expressing the loss sustained by the membership in the death within the year of its first president, Robert K. Sheppard, was adopted.

Election of officers for the following year resulted as follows: President, J. F. Kerlin, Corliss Carbon Company, Bradford, Pa.; vice-president, Le Roy Clark, Safety Insulated Wire & Cable Company, New York; treasurer, J. W. Perry, H. W. Johns-Manville Company, New York; general secretary, Charles E. Dustin; to the board of governors, W. F. Field, H. D. Hanks, Shiras Morris, W. H. Thornley, J. H. Trumbull

Record Run at Providence 45,000-kw. Turbine

THE 45,000-kw. cross-compound Westinghouse turbo-generating unit of the Narragansett Electric Lighting Company, Providence, R. I., was shut down a few days ago after a continuous run of eighty-four days, eleven hours and thirty-six minutes. Nicholas Stahl, general engineer of this company, states that to the best of his knowledge this constitutes a world's record run for continuity in units of this type. During this period the unit generated 50,781,000 kw.-hr., which exceeds the annual output of the company for any year prior to 1915. The load varied on the machine from 6,000 kw. to 41,000 kw. To produce this output required 609,000 lb. of steam, with a coal consumption of about 71,000,000 lb., or 1.4 lb. per kilowatt-hour. About 27,500,000 000 lb. of condensing water was required.

Decision in Kansas City Contract Case Expected Soon

ARGUMENT has been had before the Supreme Court of the United States in the case of the Kansas City Bolt & Nut Company vs. the Kansas City (Mo.) Light & Power Company, and a ruling from the court of last resort is expected in the near future. A contract was entered into between the two companies concerned in the suit for the delivery of electrical energy. The contract was dated Sept. 7, 1912, or prior to the creation of the Missouri Public Service Commission, to which were given rate-fixing powers. The contract fixed the compensation and other conditions for a period of five years, with the proviso that at the option of the consumer these conditions could be renewed thereafter from year to year for a period of ten additional years. After supplying power for three years, the Kansas City light company insisted upon applying rates which had been prescribed by the Public Service Commission. The lower courts, including the Supreme Court of the State of Missouri, have refused to enjoin the Kansas City Light & Power Company from withdrawing power from the manufacturing plant.

High-Voltage Outdoor Substations Show Saving in Cost

POWER-FACTOR correction and outdoor substations were discussed at an open meeting of the transmission and distribution committee of the Ohio Electric Light Association held at Canton on March 18.

In an illustrated paper on the history of equipment for high-voltage outdoor substations by Stephen Q. Hayes of the Westinghouse Electric & Manufacturing Company the cost comparisons between a 135,000-kva. hydro-electric station and a 154,000-volt outdoor substation showed a saving of about 13 per cent in favor of the latter. Mr. Hayes said that about 80 per cent of modern high-voltage transformers are designed for outdoor service.

Advantages and disadvantages of synchronous motors, synchronous condensers and static condensers for power-factor correction were outlined in a paper on power-factor corrective apparatus by Robert Treat of the General Electric Company. At the close of the meeting an inspection trip was made to the 132,000-volt stepdown substation of the Central Power Company in Canton.

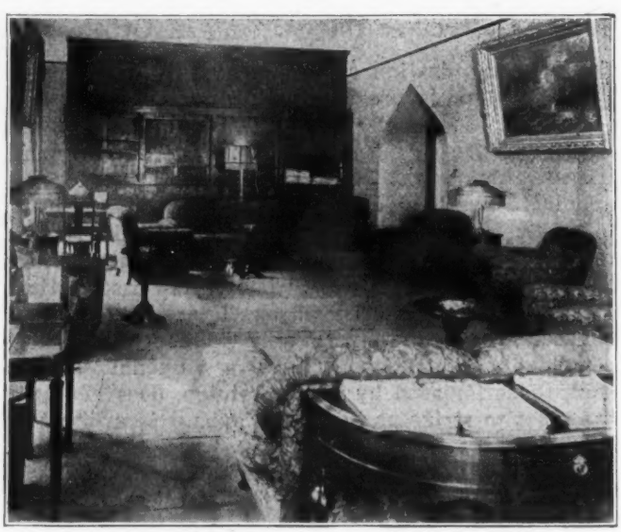
Merger of Two Prominent Engineering Firms Effected

THE plan for the merger of Westinghouse, Church, Kerr & Company, Inc., with Dwight P. Robinson & Company, Inc., as was outlined in the ELECTRICAL WORLD of March 13, was declared operative on March 18. Dwight P. Robinson has been elected president of Westinghouse, Church, Kerr & Company pending final completion of the merger.

It was stated at the office of Dwight P. Robinson & Company that the Westinghouse Electric & Manufacturing Company, the largest stockholder of Westinghouse, Church, Kerr & Company, will withdraw as a stockholder from the new company and that Guy E. Tripp will remain as chairman of the board of Westinghouse, Church, Kerr & Company only until the organization of the new company is completed.

Details of the new organization have not been fully worked out, but it was stated at the office of Dwight P. Robinson & Company that it is planned to retain the personnel of both of the merging companies. The new company will have an engineering office in the Grand Central Palace, New York City, and the present office of Dwight P. Robinson & Company, at 61 Broadway, will also be retained.

Chicago Electric Club Opens Permanent Home



THIS comfortable "lounge" is one of several rooms in the Morrison Hotel, Chicago, that are now the permanent quarters of the Chicago Electric Club. On March 4 the quarters were officially opened to the club's 800 members and their guests. All told, the floor space, leased for five years by the club at an annual rental of $15,000, is 5,500 sq.ft. This is divided into seven rooms, including "lounges," a billiard room, a ladies' room and a dining room. For the club's large weekly luncheon gatherings the hotel provides the use of its main banquet hall. Among the new offers which the club is making is a non-resident membership for $15.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Another House Organ Appears.—From the Merchants' Heat & Light Company of Indianapolis comes the first number of *Flash*, a company news sheet.

Healthy Condition of Western Utility.—An indication of the condition of the Western public utilities is given by the recent report of the Pacific Gas & Electric Company showing that the number of its preferred stockholders, which on Jan. 1, 1919, was 6,411, on Feb. 10, 1920, had increased to 7,441. On the latter date there were 2,281 holders of common stock.

New Zealand Government Purchases Hydro-electric Plant.—United States Vice Consul Charles G. Winslow writes from Auckland that the New Zealand government has purchased the Horahora hydro-electric system from the Waihi Gold Mining Company for the sum of $1,034,131, with the view of distributing electricity to the Waihi Gold Mining Company, industrial enterprises and homes in the Auckland province south of Auckland.

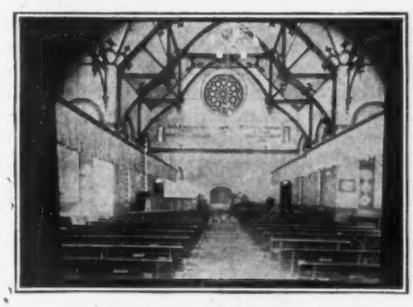
New Home for West Penn. — The Hartje Building, a twelve-story structure at First Avenue and Wood Street, Pittsburgh, has been purchased by the West Penn system as a home for its executive departments at a cost of $560,000. The new owner will take possession on June 1, from which date the structure will be known as the West Penn Building. At present the associated companies occupy 21,000 ft. of floor space in Pittsburgh alone, principally in the Benedum-Trees Building. The acquisition of an entire building was necessitated by the growth of the West Penn Railways Company and the West Penn Power Company.

Civil Service Examinations for Electrical Engineers.—The United States Civil Service Commission announces open competitive examinations for marine, mechanical and electrical engineers for which applications may be filed with it up to April 20. Salaries range from $2,400 to $4,000 a year. The duties of those qualifying as electrical engineers will require training and experience in electrical machinery construction, testing of electrical machinery, and installation of electric wiring, electrical machinery or radio equipment in connection with marine construction. Applicants should apply for form 2,118, stating the title of examination desired, to the Civil Service Commission, Washington, D. C., or to the secretary of any United States Civil Service board.

Electricity at Hog Island. — In an official statement concerning the status of the work of the American International Shipbuilding Corporation at Hog Island, Pa., as of March 10, 1920, the length of wiring used to convey electricity to this mammoth enterprise, with its 103 acres of floor space and its 25,000 employees, is put at 675 miles. This figure is exclusive of telephone wiring, which reaches an aggregate of 3,000 miles.

Plant Operates Amid Flood Conditions.—An illustration of the efficiency of the main West Reading (Pa.) plant of the Metropolitan Edison Company was given recently when the plant was kept running without a moment's interruption during a 17-foot flood in the Schuylkill River, from which water is drawn for condensing purposes. The flood forced its way into the power station, pumps and similar equipment on the ground floor being completely submerged. The engineers succeeded in keeping one of the boiler-feed pumps running, although covered by several feet of water during the height of the flood, and this made possible the continued operation of the plant with little reduction of service.

Electricity Replaces Coolie Labor.—The punkas shown in this Baptist church in Rangoon, Burma, and which look like draperies hung from a gallery, are really electric fans, the motor having replaced the coolies who used to operate them in the intervals during which they could keep awake. "In the hot weather the fans are indispensable," says the pastor of this East Indian church. "It was a comparatively simple matter to rig them up to



run with an electric motor, and now, no matter how hot the night or how sleepy the coolies, the fans swing backward and forward with perfect regularity."

Snow Mountain Company Increases Stock.—The Snow Mountain Water & Power Company of California was authorized on Feb. 26 by the Railroad Commission of that State to issue stock to the extent of $1,500,000 for the purpose of obtaining funds with which to build a dam in Lake County to provide reservoir capacity of approximately 73,000 acre-feet. In addition to the dam, which is to be constructed on what is known as the Gravelly dam site, the company intends to make changes in its generating plant and so increase its efficiency by approximately 25 per cent.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Empire State Gas and Electric Association.—The next meeting of the electric meter section of this association will be held on Aug. 27.

A. I. E. E., Philadelphia Section.—At the meeting of this section on April 12 Dr. Comfort A. Adams will speak on "Electric Welding as Applied to Shipbuilding."

Ohio Electric Light Association.—The annual convention of this association will be held at the Breakers Hotel at Cedar Point, Ohio, from July 13 to July 16.

National Association of Electrical Contractors and Dealers.—The twentieth annual convention of this association will be held in Baltimore next October.

A. I. and S. E. E., Birmingham Section.—An inspection trip through the nitrogen plant of the Government will be made by the members of this section next month.

A New A. I. E. E. Section. — The board of directors of the American Institute of Electrical Engineers has granted the petition asking permission to establish a local section of the Institute at Providence, R. I.

New York Electrical Society.—At a joint meeting of this society and the Aëro Club of America held in New York on Tuesday of this week Handley Page gave an illustrated address on the future of commercial aviation.

Missouri Association of Public Utilities.—This association will hold its next annual convention at Jefferson City, Mo., on June 3 to 5 inclusive. F. D. Beardslee, Mercantile Trust Company, St. Louis, is the secretary-treasurer of the association.

Minnesota Electrical Association.—The Minnesota Electrical Association will hold no annual convention this year as plans have been completed for making this association a section of the National Electric Light Association. When this geographic section is formed a meeting of the section will probably take place.

Pennsylvania Electric Association.—The western geographic section of this association will meet at the William Penn Hotel, Pittsburgh, on April 21 to consider the subject of power-factor correction and the methods of charging consumers who maintain power factors less than unity. Members of the Ohio Electric Light Association have been invited to meet with the Pennsylvania men.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Monopoly and Competition.—An electric utility, according to a finding of the Maine Public Utilities Commission, ought not to expect protection from competition where it cannot or will not extend service to applicants in cases necessitating little or no electrical equipment.

Higher Rates Made of Short Duration.—Complaints against an increase in the price charged for electrical energy by the Rockland Light & Power Company from 13 cents a kilowatt-hour to 15 cents less 1 cent for prompt payment having been made to the New York Public Service Commission. Second District, that body, in view of the unusually expensive operating conditions of 1918, confirmed the rates but made its order of short duration in the hope that conditions may so change as to justify at the end of the period a reduction in rates satisfactory both to consumers and to the company.

Adjustment of Residence and Power Rates.—In finding that a primary residence rate of 10 cents a kilowatt-hour is not discriminatory upon comparison with a monthly minimum power charge of $50 for 1,500 kw.-hr. plus 2 cents a kilowatt-hour for excess energy, the Public Service Commission of Missouri has held that differences between residence electric rates and power electric rates which disappear upon comparison on the hours' use of demand per month basis and which are due to differences in the service rendered and justified on the basis of cost do not discriminate against residence consumers.

Principles of Rate Fixing.—In a complaint by the city of Fargo, N. D., against the rates of the Union Light, Heat & Power Company, the North Dakota Board of Railroad Commissioners laid down these principles, among others, governing the fixing of rates: (1) Unit prices based on a five-year period, with 1916 as the index, include a fair consideration of present high prices in making a valuation; (2) in the main, 3½ per cent is a sufficient and adequate allowance for depreciation in a valuation for rate making for all of the general property of an electric utility; (3) the property of a utility devoted to the service of electric, gas and steam-heat consumers should not be treated as a unit in a valuation for rate making but should be apportioned between the different services; (4) an allowance of 8 per cent for return on the fair present value of the property of an electric, gas and steam-heating utility is reasonable.

Ascertainment of Discrimination.—For the purpose of ascertaining whether a class of consumers is being served at a loss, and if so to bring about a readjustment of rates, an assignment of revenue and expense incurred in each class of service, including depreciation and return on the property used, must be made, according to a recent decision of the Public Service Commission of Missouri.

Supervision Costs as an Element in Capitalization.—In granting an application for permission to float a bond issue made by the Twin State Gas & Electric Company, the New Hampshire Public Service Commission criticised the practice of the company in adding 10 per cent to the cost of construction to cover supervision by its own officials, employees' liability insurance and other expenses paid out of operating income but incurred for the benefit of construction. The 10 per cent is not added to payments for supervision outside the company's regular operating force. The commission expressed its conviction that in the case under consideration the charge did not represent more than it should, but held that the method of computing it was arbitrary and therefore not accurate.

Items to Be Excluded or Included in Valuation for Rate-Making Purposes.—In the complaint of the Engineers' Incitation Club against the Union Electric Light & Power Company of St. Louis, the Public Service Commission of Missouri has laid down principles of valuation for rate-making purposes under which the following items are excluded from consideration: Sums set up on the books against franchises, in the absence of evidence of payment therefor to the State or a political subdivision thereof; royalties and licenses on patents which have expired; costs of establishing the business where the utility's classification of accounts provides for the charging of such items against operating expenses; non-existent property or excess purchase price of property over the value thereof; bond discounts and organization expenses, which should be amortized; excess land purchased in acquiring right-of-way; syndicate expense of selling stock and bonds; discounts allowed on commodities purchased upon a license agreement which has lost its value on account of the expiration of patents. The following items are approved by the commission as entitled to capitalization: Cost of promotion and preliminary surveys; value of leaseholds; average overhead allowances of 18.1 per cent of specific construction to cover interest, taxes, acquisition, legal and engineering expenses, omissions, contingencies and insurance; privileges to place poles in foreign pole lines, easements covering installation of poles and wire crossings and the maintenance of contacts on poles of foreign companies, upon the basis of the saving effected; accrued depreciation due to wear and tear, obsolescence and inadequacy, and vacant ducts laid under municipal compulsion.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Rate-Fixing Powers of Public Service Commission.—If an order of the Public Utilities Commission fixing rates does not contravene any constitutional limitation, and is within the constitutional and statutory authority of the commission, and has substantial basis in evidence, it cannot be set aside by the courts. This is the determination of the Supreme Court of Illinois in State Public Utilities Commission vs. Springfield Gas & Electric Company. A court, it further holds, is without authority to set aside such an order of the commission unless it is against the manifest weight of evidence, and all doubts as to the propriety of means or methods should be resolved in favor of the commissioners. (125 N. E. 891.)

Condemnation Proceedings Taken Unconstitutionally.—The Supreme Court of Colorado has held that, in proceedings to condemn right-of-way for an electric power line, if an interlocutory order, before service of summons and without notice to landowners, permitting petitioner to take possession of the right-of-way violated constitutional provisions as to due process and the taking of property without just compensation, such order did not vitiate subsequent proceedings for condemnation, duly had; and where the landowners received notice and had their compensation judicially ascertained, judgment of condemnation will not be reversed on error because of such interlocutory error unless it injuriously affected their rights on the merits of the case. (186 P. 910.)

Powers of Oklahoma Commission.—Concerning the authority of the Corporation Commission of Oklahoma the Supreme Court of that state, in Muskogee Gas & Electric Company vs. State, has held (1) that the commission is not confined to prescribing permanent rates but may enforce temporary ones when occasion arises; (2) that its power to fix rates is not limited to complaints filed but is inherent in the powers delegated to it; (3) that its inquiries should not be too narrowly constrained by technical rules as to the admissibility of evidence; (4) that the right of the courts to review its conclusions is limited to determining whether the board acted within the scope of its authority or whether the order is without foundation in evidence or a constitutional right of the public utility has been infringed by fixing confiscatory rates or rates inadequate to return a reasonable profit. (186 P. 730.)

Men of the Industry

Changes in Personnel and Position—Biographical Notes

H. L. Wills, formerly electrical engineer of the Georgia Railway & Power Company, Atlanta, Ga., was made electrical engineer and operating manager of that company on Feb. 1. Mr. Wills has had a broad central-station experience in the engineering field. He entered the employ of the Georgia Railway & Electric Company in 1902 and remained with this company until 1907, holding positions as the head of the meter and repair departments. During that time he organized the testing department. In 1907 he resigned to become engineer and general manager of the Savannah (Ga.) Lighting Company.

H. L. WILLS

That position he held until 1912, when he was made special representative of the Georgia Power Company in charge of its Macon (Ga.) district office. Upon the merger of the Georgia Railway & Electric Company and the Georgia Power Company into the Georgia Railway & Power Company he entered into the employ of the latter company, and has since held various posts of a special engineering character. On Feb. 1, 1919, he was appointed electrical engineer, a position which, as already mentioned, was merged with that of operating manager on Feb. 1, 1920. Throughout his career Mr. Wills has been identified with constructive work of the American Institute of Electrical Engineers, the National Electric Light Association and other engineering societies, in all of which he maintains a very active interest.

A. V. Guillou, of the engineering department, Southern California Edison Company, has been appointed assistant engineer of the gas and electric division of the California Railroad Commission. Mr. Guillou was graduated from the University of California with the class of 1912 and spent the two following years with the Westinghouse Electric & Manufacturing Company in Pittsburgh. He then joined the organization of the Pacific Light & Power Corporation and upon the purchase of the Mount Whitney Power & Electric Company became district agent at Porterville. Later he was transferred to the engineering department of the company.

George M. Ogle, formerly chief electrical engineer of the United States Shipping Board, Emergency Fleet Corporation, has joined the engineering force of the Vulcan Iron Works, Inc. Jersey City, N. J. in charge of its electrical contracting and consulting engineering department.

J. B. Fisken, formerly chief engineer of the Washington Water Power Company, Spokane, Wash., has been appointed consulting engineer of that company. V. H. Greisser, formerly of the engineering staff, has been promoted to the position of chief electrical engineer.

G. C. Miller, manager of the light and power department of the Aurora, Elgin & Chicago Railroad Company, Elgin, Ill., has resigned to engage in the electrical merchandising business in Kokomo, Ind., under the name of the Lacey-Miller Company. Mr. Miller was at one time a member of the new-business department of the American Gas & Electric Company at Muncie, Ind.

Walter Neumuller, who was appointed assistant secretary of the New York Edison Company early this year, was elected secretary of the company on Feb. 16. Mr. Neumuller's progress in the company has been rapid. He started in a clerical position in 1900 and advanced to the position of private secretary to Arthur Williams, general commercial manager. In 1918 he was placed

WALTER NEUMULLER

in charge of all retail business of the company, which position he has held since that time. He is an active worker in a number of electrical organizations, including the National Electric Light Association.

Dr. Irving Langmuir of Schenectady, N. Y., whose electronic and atomic researches in the laboratories of the General Electric Company have led to the notable contribution to electrophysics known as the Langmuir postulates, was last month for the second time made the recipient of the Nichols medal of the American Chemical Society. The presentation was made by Dr. William H. Nichols, past-president of the society, who dwelt on the originality and scope of Dr. Langmuir's work. The latter, who was born in Brooklyn, N. Y., in 1881, and was graduated from Columbia University

IRVING LANGMUIR

in 1903 with the degree of metallurgical engineer, did post-graduate work in chemistry at the University of Göttingen, Germany, and received the degrees of M. A. and Ph. D. from that institution. In 1906 he became an instructor in chemistry at the Stevens Institute of Technology, Hoboken, N. J., going from there in 1909 to the research laboratory of the General Electric Company, where he has ever since been engaged. To his researches can be attributed much of the advance made in the manufacture of tungsten lamps. Electric heating devices also have been the subject of his investigation. Thus he has devoted himself alike to practical and theoretical research. Dr. Langmuir has been a frequent contributor of papers at conventions of national scientific bodies, notably the American Institute of Electrical Engineers, American Electrochemical Society and American Chemical Society.

Emmet N. Britton has resigned his post as superintendent of gas distribution at Sacramento, Cal., for the Pacific Gas & Electric Company to become associate editor of the *Journal of Electricity*, the Pacific Coast publication of the McGraw-Hill Company. Mr. Britton was graduated from the University of Cailfornia in 1914 and was employed by the Pacific Gas & Electric Company until the United States entered the war, in which he saw active service in France. He is a son of John A. Britton, vice-president and general manager of the Pacific Gas & Electric Company.

Trade and Market Conditions

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

Magnet Wire Shipments Long Under Heavy Demand

MANUFACTURERS of magnet wire are unable to satisfy the present demand. As far as can be learned there is no mill capacity available under three months, and from that length of time it runs up to nine months in one case. Producers have been carried away by this unprecedented condition, and there is apparently no immediate relief from the situation.

In the case of the cotton-covered magnet wire the greatest factor in the shortage is the dearth of long-fiber cotton. When this supply would increase no one was prepared to say. For enamel wire there was found no particular shortage of enamel, although its price has been constantly increased by the manufacturers. The inability to turn out any more product under present capacity seems to be the main cause.

Low Stocks of Wiring Materials Rule in Boston

A REPORT of conditions in the Boston jobbing industry early in March shows the extent to which stocks have been depleted in ten representative items. In few cases were they at all satisfactory as to volume and range of sizes carried, and in some cases the stock varied from zero to a nominal quantity from day to day.

Out of six representative jobbers, five were entirely out of single-strip and four out of double-strip flexible armored conductor. Four had no metallic flexible conduit and the same number had no loom. Two had no stocks of tubes and only one had any stock of "Nail-it" knobs. There was a certain quantity of sockets in all hands, and each had some pipe and some tape. Cotton lamp cord could be found in small amounts except in one case where there was none. Every jobber was entirely out of at least one of these items, and one was out of all but sockets, pipe and tape.

Fiber Conduit Mills Booked Up to Good Capacity

UTILITIES have been purchasing fiber conduit in large quantities this spring and mill capacities have been booked for many months ahead. The supply of pulp from Canada is in satisfactory condition for all requirements anticipated for the year. Conduit mills are running in a comfortable capacity, but if they are required to resort to extra shifts to supply a sudden demand in the summer it is expected that a price advance will result, possibly to the extent of 20 per cent.

Sufficient material is on hand to satisfy the orders now booked at the prevailing rate, which has held for some time. Additional business for quick delivery would require overtime labor and fresh ordering of raw materials at a rate higher than on those already laid in. Consequently it is of advantage to utilities and others contemplating extensions wherein fiber conduit would be used to place their orders as soon as possible for shipment as far ahead as can be done, in order to get in on present prices. It is known that some large contracts have not yet been placed which undoubtedly will have to be placed before the summer is out. At this time there is a certain amount of capacity which can be turned to shipment in five to six weeks. While the popular demand is for 3-in. conduit, there has been good ordering of 4-in. stock also.

Export business is in fair shape, and although shipping rates are high, there is a good volume going to South America and to Europe. Rates slightly favor European business because of a recent drop.

Good Year Expected in Electric Passenger Car Market

THERE has been little activity in the passenger vehicle market of late. In the East, North and Middle West, where the demand is good, the closed winter has kept down buying and delivery of cars. Dealers state that they expect a very good season ahead and have on hand many cars already sold which they are holding until weather conditions shall permit their delivery. There are very few new cars available, but there is a small number of used cars on hand. New shipments cannot be had under thirty days.

There is an acute shortage of plate glass, and especially of curved plate. Because of this one passenger vehicle producer has changed the design of his body from curved to straight line to eliminate this feature. At the same time the price of the glass is more than double that of a year ago. Otherwise there is no vital scarcity of materials.

The price of the Detroit car is expected to advance by April 1, bringing it to $4,000 and placing it on a par with the Baker. Labor cost is a big factor in this product because of the high grade of hand work which is used in the finish of the body.

Steel Products Slightly Easier with Car Movements

SOME little relief is being afforded the industry in the matter of steel and iron supplies through the movement of freight after it had been storm-bound for weeks. Rigid conduit is being received almost daily in carload lots, but the mass of back orders, accumulated over the period of slack deliveries, is keeping stocks in a very depleted state. Some jobbers have no pipe stocks despite the freight movement. It can hardly be said that production has increased except that slightly better supplies of raw materials have come in to the mills with better car activity. There is no immediate relief to the pipe situation in sight because of the extremely heavy call for pipe for the gas and oil regions.

Mills are booked on conduit far into the future, even to the middle of 1921. Where the mill policy to distributers has been to allow them to order for each month of 1920 delivery up to one-twelfth of their total orders for the year 1919, this policy has been changed since the acceptance of that allotment for January, February and March, 1920. Now the remainder of the 1920 quota has been canceled, with only the first quarter satisfied.

Jobbers are having difficulty in locating pipe for some of their customers and are going to great lengths to gain their ends, but it seldom happens that the pipe is not forthcoming. One New England jobber worked virtually a whole week before he succeeded in placing a paltry single carload order. Shopping among the trade for pipe is a daily occurrence, and a New York jobber finally succeeded in picking up some pipe from a Canadian jobber.

In the flexible armored conductor market the interrupted flow of steel strip has again been resumed and the mills are back on their production basis of a month or so ago. This production, however, is apparently satisfying the needs of the trade from day to day, with the end of the stock almost always in sight before another allotment is received. It is intimated in the steel trade that an advance in price of cold-rolled steel strip is expected rather than not, which in turn would undoubtedly be reflected in a higher price for armored conductor. This would probably be in the nature of a $5 rise per 1,000 feet.

Metal molding is at present scarce, but with the resumption of shipments it is stated that within a month the trade will be in receipt of sufficient to fill its demands.

March Collections in the East Show Falling Off

REPORTS from the industry in the Eastern territory indicate a slight retrogression in the credit situation. Jobbers are watching their collections very carefully and are firmly but quietly pushing overdue accounts. From some sources it appears that industrials are falling behind in their payments, and this has applied not only to small concerns but also to some large factories. Contractors and jobbers too are found in the list. One reason advanced for this is the effect of income tax payments on available funds after a long protracted season of poor shipments and deliveries.

Material billed at time of shipment in January and February has in many cases not been received until well into March, and some is just now coming in. Consequently the consignees, not having had the material to sell, have hesitated to pay in many cases, and collections are suffering; at the same time their receipts have fallen off because of this lack of material and their available funds have been depleted. This, on top of the income tax, is effecting a lower standard of collections at this time. One jobber reports a heavy falling off in discounted bills, and another has noticed it to some extent.

Orders on Hand Unreliable as Basis for Future Business

MANY electrical manufacturers and jobbers in the central part of the country are fortifying themselves against an expected period of depression by shortening up on credit, by taking up their loans as rapidly as practicable and by getting a large volume of orders on their books. After deducting the cancellations which they feel are bound to come they hope to have plenty of unfilled orders to help tide them over the dull period. Deliveries have been so long and uncertain that it has been a common practice to duplicate orders with different manufacturers, and it has been a very general practice to place orders recklessly without counting the cost. This condition seems to have come to an end in some other lines of business, and the electrical industry of the Middle West is beginning to get its own house in order.

The rising interest rates have begun to slow up mercantile activities in the Central States. Many wholesale merchants believe that the peak of prices has been practically reached in mercantile, building and industrial lines and a period of price recession is looked for. Some of the banks have told commercial borrowers that to continue their policy of doing business on the basis of war inflation will extend the period of high interest rates and will lead to ultimate losses. Business men have also been advised to watch the foreign exchange situation and conditions which may grow out of it.

Foreign manufacturers have already established sales agencies in this country, and the rapidly growing volume of imports indicates that foreigners intend to make more and more use of the low rates of exchange to help them compete with local manufacturers in the American market. These increasing imports, especially when coupled with our decreasing exports, will of course tend to improve exchange rates, but the Federal Reserve Bank of Chicago says it will be a slow process. While exchanges are still low, foreign manufacturers expect to undersell Americans profitably in the United States. If imports are allowed to come unchecked and foreigners capture an appreciable amount of American business American manufacturers may expect to build up surplus stocks which they will probably try hard to sell abroad. After business has been readjusted on a peace basis and the process of squeezing the water out of the financial structure has been completed business men in all lines expect an era of big business and true prosperity to follow.

Early Fan Orders Far Surpass Those of Previous Seasons

FROM the standpoint of the manufacturer and the distributer, the fan season is well under way. In fact, it is under way to a much greater extent, according to reports from fan manufacturers, than it ever was before at this time of year. By the first of March, when the Central and Northern parts of the country were snowed in, distributers had so lined up their summer business that various fan manufacturers had booked orders for two, three and even four times the volume booked at this season of the year heretofore. One producer reports his entire capacity up to the middle of June already cared for by his distributers.

This condition shows the encouraging way in which distributers and jobbers apparently have been combining their trade with dealers and showing them not only the possibility but also the probability of unfilled orders if these are not placed until the hot season descends. The difficulties manufacturers are experiencing in obtaining raw materials on time is a great drawback to rushed production, to say nothing of the labor shortage which now exists and which is hardly expected to become any better by the time the summer season is on.

An increase in prices in the neighborhood of 20 per cent over those of last year certainly is not acting as a brake on early-season fan orders. From all appearances the electric fan is out of the luxury class and is being bought for its utility. Of special note is the increase in business being done in the 16-in. types. Orders so far indicate an especially heavy demand for this large size. At the same time it is not expected that the demand for the smaller sizes will in any way fall off, because already the 9-in. and 6-in. sizes are proving very popular in the ordering.

Manufacturers have stated that they expect the season to continue heavy and would not be at all surprised if there still was insufficient producing capacity to satisfy it. A hot spell last June played havoc with some jobbers' stocks. A similar hot spell this coming June probably would not have the same effect because of the heavy advance ordering, but a second one following closely on the heels of the first would without doubt find some jobbers with a pretty badly broken assortment of fans. The situation as a whole, however, is on a very satisfactory basis, especially compared with that of former years. Many carloads of fan motors have already found their way into distributers' warehouses, while more are still en route from factories.

Quick Unloading of Freight Helps Relieve Car Shortage

THE seriousness of the car shortage is daily being brought home to electrical manufacturers and jobbers. Certain railway companies are demanding that their cars be sent back to their own lines immediately—cars which had been allotted to other lines while the roads were under Government control. In cases this insistence has been so great that freight cars have gone back empty where with a little manipulation they could have picked up a load, although at a cost of a few days' further delay. This recall of cars to their home lines is undoubtedly going to cause a still greater car shortage than now exists on certain lines and divisions, but it will benefit the home lines.

Pressure is being brought to bear on industrial plants and business houses to expedite the unloading of freight and the release of greatly needed cars for service. This pressure might well be applied, it seems, to the element which is refusing to handle freight at this time along the Atlantic seaboard. Here hundreds of cars will remain loaded with the materials which normally would have quickly been transferred but for which there is no storage space except the very cars in which they came.

Very heavy weather conditions have held up cars throughout the whole winter season, but particularly from the first of the year on. It is only now that some of them are finding their way to their destinations and helping to relieve the critical situation that exists. One manufacturer reports that of one hundred cars ordered from the railway to remove finished products from his factory only nineteen were sent, and of this number nine were unfit for use because they leaked so badly it would have been unsafe to trust the materials to them. One jobber reports the receipt of rusted heating devices in a recent shipment made during a storm. It has been virtually impossible to withdraw cars from service for repairs because they were so badly needed. Recent orders placed with car builders promise to give some relief to this situation in the near future. With the condition of steel deliveries this relief is even more likely, because it is understood that steel for railway purposes is getting the preference over that for other industries.

Many manufacturers have resorted to express shipments, and although units have been limited to 200 lb. each, a great amount of material has been delivered in this way. A report just received gives freight shipments from Schenectady to New York City at thirty days, while express is coming through in ten days. Furthermore, manufacturers have of late been using the parcel post for shipments up to 50 lb., and a surprising amount of business is being handled in this way. The consumer, it is said, pays the bill in the end.

It cannot be too strongly urged that manufacturers and all others handling freight expedite in every possible way the unloading of cars in order to effect a quick turnover of rolling stock.

Metal Market Situation

COPPER has been moving in large quantities since last Saturday, and the market is extremely strong. Producers are holding their price at 18.75 cents for April, May and June delivery and are showing no desire to sell for third quarter. With all the purchasing, copper consumers are known to be without enough of the metal to last over the second quarter, and further activity in the market is expected.

The second-hand market is rather inactive, and dealers have been playing the part of lookers-on, believing that the price is going to 19 cents at least within a few days and desiring to hold off and see. This price of 19 cents is relatively low for copper when present costs of production are considered. In fact, copper prices show less rise over pre-war prices than those of other metals.

NEW YORK METAL MARKET PRICES

	March 16	March 24
Copper	£ s d	£ s d
London, standard spot	107 0 0	108 0 0
	Cents per Pound	Cents per Pound
Prime Lake	18.50 to 18.75	19.25
Electrolytic	18.12½	18.75
Casting	17.87½	18.37½
Wire base	22.25	22.50
Lead, trust price	9.25	8.85 to 9.15
Antimony	11.00	10.75
Nickel, ingot	43.00	43.00
Sheet zinc, f.o.b. smelter	12.00	12.50
Spelter, spot	8.85 to 8.95	8.85
Tin	62.00	60.75 to 61.25
Aluminum, 98 to 99 per cent	33.00	33.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	15.50 to 16.00	16.00 to 16.50
Brass, heavy	10.00 to 10.25	10.00 to 10.25
Brass, light	8.50 to 9.00	8.50 to 9.50
Lead, heavy	7.75 to 8.00	7.75 to 8.00
Zinc, old scrap	5.00 to 5.25	5.00 to 5.25

THE WEEK
IN TRADE

CONSIDERABLE activity is reported from virtually all over the country, but in particular from New England, the Middle West and the South. The New York district is not quite up to the mark.

Shipments are coming through in a little better shape, but the supplies of pipe, conductors, loom and other materials which do come in are immediately prorated on back orders and shipped out again. Wire stocks are good except in the Chicago district. All the specially covered wires, such as magnet wire, cords and annunciator wire, are in very bad shape and deliveries are at best three months off. In sections far from the mills schedule materials are very low in stock, although the mills are getting out better production.

Building is active all over the country except in New York City. There it is almost stagnant. Strikes in certain parts of the building trades are keeping builders out of the market because of the risk of shut-downs if they should start operations. Housing projects and private building are progressing well.

Collections as a rule are good but are being closely watched.

NEW YORK

Demand for electrical supplies is not quite up to that experienced by the trade in the latter months of 1919. Of course, the shortage of many materials is holding back some business, but few jobs, it appears from reports, are really suffering because there is no equipment to complete them. One jobber thinks he could increase his business 30 per cent if he could get materials. Probably most jobbers are in a similar condition, but a big part of this increased business undoubtedly would go to fill back orders and be spread around for stocking purposes.

The delivery situation has bettered to some degree but is very far from satisfactory. Small shipments are coming in, it is true, but in many cases they are shipments that have been in transit since January and February. This is reacting on credit standing with billings up to two months ahead of receipt of goods. Collections are off a bit, possibly because of the influence of income-tax payments, but are being watched carefully and followed closely.

Building is almost at a standstill in New York City because of labor unrest and its apparent unwillingness to feel any responsibility in relieving the housing situation. Suburban building is progressing at a fair rate, but reaction from the city is felt there, too.

Flexible Armored Conductor.—Shipments from factory are coming through better with the release of cars, but stocks are extremely spotty and at best are low and do not last. Where the material exists jobbers are getting about $98 for No. 14 double-strip in the largest quantities they can sell, and up to $120 in small lots.

Sockets.—Here and there small stocks of pull chains may be found, while key and keyless are worse yet. Apparently manufacturers, to fill the demand for pulls, put so much energy on that type that production of the two other types suffered.

Rigid Conduit.—Small amounts of pipe are coming in, but here and there stocks are flat. Car releases should help the situation any day.

Non-Metallic Flexible Conduit.—Occasionally a jobber is found with what could be called a fair stock, but in general little is available. Some jobbers have none. A price of $45 per 1,000 ft. is being received for ⅜-in. loom.

Lamps.—Stocks in general are good, but unlooked for heavy orders are breaking holes in stocks of some distributers. In several cases the 75-watt size is short.

Bare Wire.—Base is holding at 22 50 cents, but a rise would not be unexpected. Large sizes are plentiful, but small sizes around No. 30 are in great demand for use with textiles.

Wire.—Rubber-covered business attracts no special attention and stocks are good. Shipments are around ninety days, and base price is holding around 28½ cents on an average. Jobbers' prices in 10,000-ft. quantities for No. 14 are around $11.50, and from this up to $13.50 for smaller quantities. Weatherproof base is holding around 28 cents, with an increasing demand and shipments about six weeks.

Batteries.—Dry-cell sales are being limited in many cases to available stocks. The spring demand is good, but shipments are poor.

Lamp Cords.—Cotton and silk cords are available only in extremely limited amounts. No. 18 twisted cotton lamp cord is selling at $23.25, while as high as $65 per 1,000 ft. has been paid for No. 18 parallel silk cord in 25,000-ft. quantities.

BOSTON

Business remains intensely active. A leading jobber reports 125 per cent larger sales in February than ever before for that month. Traffic tie-ups and delays merely slowed down orders for a short period, and conditions are gradually improving as regards freight movement, although the situation is still most unsatisfactory. Pressure is being brought to bear upon industrial plants and business houses to expedite unloading freight and release greatly needed cars for service. Jobbers' stocks are irregular and are very low in porcelain, rigid conduit, outlet boxes and loom. Building and engineering contracts exceed all previous records, the total placed for 1920 to March 18 in New England being $66,110,000.

Collections are somewhat improved. Prices show little change.

Wire.—Although one jobber had a million feet of No. 14 rubber-covered wire on hand at the end of the week, there is expectation of a shortage in this size and type in some wholesale circles. The demand is active, and rubber-covered, No. 14, is quoted around $11.50 per 1,000 ft. in 5,000-ft. lots and $13 for lesser quantities. Weatherproof is on a 30-cent base and bare on a 23-cent to 24-cent base. A good supply of heavy cable is understood to be available.

Dry Cells.—An advance of 5 cents per 100 cells has been effected to cover increased freight charges. No. 6 cells are quoted at $32.95 and igniters at $33.95 per 100, with good stocks. Small dry cells are moving well.

Lamps.—It is getting harder to meet demands, and some jobbers' stocks reflect shortened lines, especially in 75-watt and 100-watt units.

Flexible Armored Conductor.—Prices are firm, No. 14 single-strip bringing $105 per 1,000 ft. in coil to 1,000-ft. lots. Stocks are low and demand vigorous.

Non-Metallic Flexible Conduit.—Stocks are shot to pieces, very little loom being on hand. Quotations are steady at $37 per 1,000 ft. for $\frac{7}{32}$-in. and $40 for ¼-in. in coil to 1000-ft. lots.

Knobs and Tubes.—The flood of orders has virtually cleaned out the stocks even of leading jobbers. One of the most reliable houses had no Nail-it knobs or 3-in. tubes on hand at the week-end. These tubes are quoted at $9 per 1,000 in standard packages, and Nail-it knobs at $28 per thousand in barrel lots; but prices mean little in the present scarcity of material.

Sockets.—Pulls are easy at 47.5 cents each in case lots, keys at 28 cents and keyless at 26 cents, with plentiful supplies. For the present this material is coming through finely.

Rigid Conduit.—Famine conditions threaten, if indeed they have not already arrived. One jobber spent practically a week before succeeding in placing a carload order, and the mills are talking for 1921 delivery. Local stocks are hard hit, and shipments are being parceled out as much as possible. Card 44 prices obtain, with a decided stiffening in quotations. Black pipe, ½-in., brings $85.43 per 1,000 ft., and galvanized $90.53. The ¾-in. black is quoted at $113.28 and white at $120.13.

Foot-Candle Meters.—A vigorous demand has lately sprung up among central stations and contractor-dealers.

Electric Passenger Cars.—A 10 per cent advance took place last week in the factory prices of Detroit electric automobiles. Glass and tires are short. Sales of electric delivery wagons to bakers are features of the markets in Boston and Providence.

Appliances.—Staple domestic labor-saving devices continue in great demand.

CHICAGO

Local developments having to do with the immediate future of the electrical trade, particularly in schedule material, have during the past week been very encouraging. The height of buildings permitted under the municipal code was increased from 200 ft. to 260 ft., and it is anticipated that numerous projects which have been held up on account of the difficulty of erecting a building within the prescribed limits that would earn sufficient revenue will now go ahead.

The building trades labor outlook, which looked stormy for a time, bids fair to clear up. Letting of construction contracts and issuing of building permits are proceeding at a rate sufficient to promise a busy season for contractors. This week's building permits were slightly over $1,000,000. Expansion is the order of the day among electrical manufacturers in this district.

Market conditions in the main are unchanged. Orders continue to pile up in the back order files and prices remain steady. Large retailers announce the adoption of a policy of closely co-operating with national advertisers in their sales efforts of the future.

Bare Copper Wire.—Better deliveries are obtainable in this commodity than on any other item in the electrical line. Price is up a cent to a 24-cent base. In 200-lb. lots No. 8 is quoted at $25.25 per 100 lbs. and No. 12 at $25.50. In larger quantities prices are $24 and $24.50 respectively.

Rubber-Covered Wire.—Demand exceeds supply to such an extent that deliveries are six months in arrears. Orders are accepted on basis of price ruling at time of delivery. Current shipments are being billed from Chicago at $12.50 per 1,000 ft. for No. 14 and $17 per 1,000 ft. for No. 12 in 5,000-ft. lots, $11.25 for No. 14 and $16 for No. 12 in larger quantities.

Line Material.—No further price changes are reported and a slight recession in buying pressure is noted. It is felt that this can be attributed to the general financial condition rather than to any curtailment in the plans of power distributing concerns.

Locust Pins.—The advance in jobbers' price which was forecast last week has not yet gone into effect. Price ruling now on 1½-in. x 9-in. is $48 per 1,000. Deliveries are ranging from prompt to six weeks.

Lamps.—Trade in common sizes is holding up well and, barring transportation troubles, deliveries are good.

Electric Signs.—Manufacturers report excellent business with no price changes recently. Difficulties in securing raw materials are slowing up production and will undoubtedly soon result in advances.

Washing Machines and Vacuum Cleaners.—A "dollar-down sale" conducted by the Commonwealth Edison Company two weeks ago was very successful and will cause the March retail sales of these items to be considerably above par. Manufacturers are falling behind on orders and favored makes are hard to get.

Farm-Lighting Sets.—Announcement is made by the manufacturers of "Delcolight" sets as follows: Price on No. 216, a ¾-kw. outfit with large battery, is advanced to $580; No. 208 has been withdrawn from sale; additions are made for the line of a ½-kw. set with small battery at $395; a ½-kw. set with large battery is $495 and 1-kw. set with large battery is $595. Distributers will increase discounts to A and B dealers, the new figures not having been made public.

ATLANTA

All indications point to a continued brisk demand for material entering into building and home construction. Even with the high prices of building material there has been no appreciable slackening in the erection of business houses, manufacturing plants and dwellings, and new construction is announced daily.

Continued difficulty is experienced in obtaining supplies of material requiring steel, cotton or porcelain. The car shortage is aggravating shipping conditions, with resultant difficulty in obtaining supplies of commodities from manufacturers. Shipments are coming through very slowly. Jobbers anticipate, however, that spring weather will assist in relieving this shortage and that large quantities of material already shipped will be delivered shortly. Building permits in the city of Atlanta from March 1 to March 15 amounted to approximately $500,000. Bank clearings continue to show a 30 per cent increase over the corresponding period of last year.

Conduit.—No change for the better in stocks is to be noted, the situation continuing acute, especially in the popular sizes.

Wire.—Good shipments have enabled jobbers to accumulate fair stocks of weatherproof and rubber-covered, despite brisk demands. Satisfactory quantities of No. 6, No. 8 and No. 10 are, however, not yet on hand. Jobbers report varnished-cambric cable very difficult to obtain and there are no stocks of moment in the territory.

Schedule Material.—No improvement in schedule material stocks can be reported; in fact, poor deliveries coupled with brisk demands are serving materially to deplete stocks throughout this section. Prices are quoted as follows: Key sockets, 49 cents; snap switches, single-pole, 5 amp., 42 cents; fuse plugs, 8 cents; split knobs, $3.20 per 100; friction tape, 60 cents per pound.

Flexible Armored Conductor.—Some improvement is to be noted in the available supplies of this article. Orders placed several months ago are beginning to come in and are serving to relieve somewhat the shortage that has existed for several weeks. Prices are quoted as follows: No. 14, two wire, 250 ft. to 1,000 ft., $12.22 per 100 ft.

Non-Metallic Flexible Conduit.—Despite the receipt of orders placed six months ago, there are still far from sufficient quantities of this material available on local markets. Jobbers do not offer much encouragement for the betterment of the situation. Prices are quoted as follows: 250 ft. to 1,000 ft., $\frac{3}{8}$-in., $6; $\frac{1}{2}$-in., $5.50 per 100 ft.

Pole-Line Material.—The greatest demand for several years is noted in all lines of pole-line material. The shortage in cross-arms due to the lumber situation and in pole-line hardware is holding up the construction of a quantity of proposed extensions. Chestnut poles are quoted: 30 ft., $5.75; 35 ft., $6; cross-arms, pine, four-pin, 4 ft., 77 cents; six-pin, 6 ft., $1.15.

Portable Drills.—Heavy buying has badly depleted local stocks. Jobbers report a growing appreciation of this labor-saving device and predict a steady increase in the demand for it. A number of jobbers are placing orders in quantities. Shipments are reported from three to six weeks.

SEATTLE—PORTLAND

Conditions in the electrical industry in Seattle and Puget Sound cities show no particular change over those of the past two weeks, except that stock shortages along nearly all lines are becoming more acute. This condition exists in the face of a brisk demand, especially for schedule materials, including house-wiring devices of all kinds, labor-saving devices and fractional-size motors. Pre-spring building, which continues to show increasing growth, is liable to be retarded to a considerable extent unless portion shipments of schedule materials and wiring devices arrive at an early date. Advices from the Gray's Harbor country and western Washington points state that the shortage of certain materials is serious and that building is being held up.

Manufacturers' representatives in the Portland district report that there is a very good demand for goods, but that the general bulk of business is slow on account of such a shortage in supply. They report a great scarcity in motors of all lines and that deliveries are long for practically every line of material and apparatus. Six or seven months' delivery seems to be about the best that can be obtained.

Spokane jobbers report general volume of sales increasingly good and building showing noticeable increases from week to week. Small motors for grain elevators, fruit canneries, garages, etc., are showing fine movement, and recently several sales of moment of electrical apparatus for mining uses were noted. The prime activity, however, is still confined to household appliances, especially washing machines, ranges and sewing machines. The movement of toasters, flatirons, percolators, etc., is well sustained.

Metallic Flexible Conduit.—There has been a noticeable increase in demand which so far has been met, but stocks are running perilously low. Shipments are coming through very slowly.

Conduit.—Stocks are practically exhausted in the case of nearly every jobber and shipments are negligible. Fortunately, in the face of shortage or entire depletion of stocks in many cases, the demand is light.

Flexible Armored Conductor.—Very poor stocks are reported and the demand far exceeds available supply. Shipments due in Seattle but still on the road will do much to relieve the local situation.

SAN FRANCISCO

Building continues brisk, with many residences and apartment houses under construction. No very large structures are under way, but there is much business in remodeling stores. Electrical firms are making a gratifying showing in this respect. Sales of heating devices are very good. Household devices are held up in some cases by poor deliveries, but in general continue lively. Collections are good; in fact, the recent continued rains have revived the usual state of optimism.

Heating Devices.—Percolator stocks are especially poor as only a few of the pot styles are to be had. Some factories will not accept orders for percolators until they shall be able to cope with present orders on hand. A rather mild winter has hurt the heating-pad sales, and dealers are carrying over good radiator stocks for next season. Some manufacturers are soliciting advance orders for 1921 radiators.

Fixtures.—"Duplexalites" have advanced from 25 to 50 per cent on various styles, and some dealers are inclined to be pessimistic over the effect of this advance, claiming that it will chill the growing business. Jobbers' stocks are good, and dealers who have gone after the business report a receptive public.

Plugs.—Jobbers report good stocks and good demands for attachment plugs, especially in the higher priced separable types. Price does not seem to influence sales except in the case of a few manufacturers of products employing attachment plugs who sometimes specify one-piece plugs on a bid basis.

Sockets.—Pull candelabra sockets are very popular just now and Coast stocks are exhausted. Firms making special portables and fixtures for the remodeling of the finer shopping stores and cafés are responsible for this unusual demand.

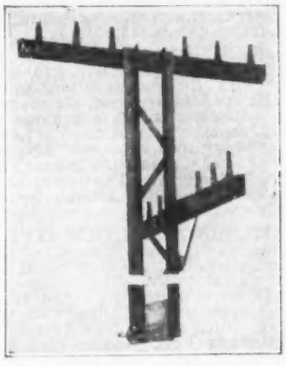
Vacuum Cleaners.—Slow deliveries are rather hurting the sales, but it is a fact that the special makes, which are not legitimately represented on the Pacific Coast, seem to be getting the bulk of the business. There is more and more of a tendency on the part of dealers to stock many different makes, but the shrewder dealers are limiting their stocks to one or a limited number of types and such dealers report good turnovers. Prices are very steady. Few dealers are availing themselves of the collecting services of banks.

NEW APPARATUS & APPLIANCES

A Record of Latest Developments
and Improvements in Manufacturers' Products
Used in the Electrical Field

Steel Extension Pole Top

The steel extension frame designed for adding 10 ft. or 15 ft. to the length of wooden poles which is made by S. W. Hull & Company, 3729 Prospect

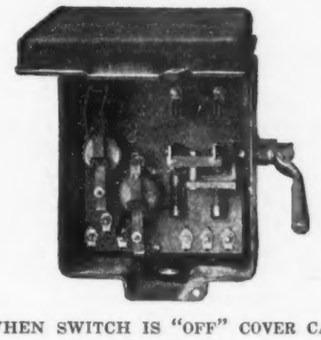


FITS 6-IN. TO 10-IN. POLE

Avenue, Cleveland, Ohio, has been improved so that it will fit on any pole from 6 in. to 10 in. in diameter and will hold a crossarm at right angles to the direction of the main line.

Automatic Starter With Cast-Iron Inclosing Case

An automatic starter of the inclosed type, which may be operated by a self-contained knife switch with external handle or controlled from a remote point by a push-button master switch, has recently been put on the market by the Cutler-Hammer Manufacturing Company of Milwaukee and New York. This starter is for use with small direct-current motors not rated over 2 hp. at 115 volts or 3 hp. at 230 volts.



WHEN SWITCH IS "OFF" COVER CAN BE LIFTED

The automatic feature is obtained by an accelerating contactor which closes when the motor attains about three-fourths full speed and automatically shunts out the starting resistor. A magnetic main-line contactor mounted on the panel allows remote control from two push-button switches of the momentary-contact type. A common snap switch, a float switch or a pressure regulator can also be used for remote control of the motor. When remote control is not desired the magnetic main-line contactor is omitted and the motor is controlled by a fused knife switch mounted on the panel with an operating handle outside of the case. The handle can be locked in the open position to prevent unauthorized operation. Interlocks prevent lifting the cover while the switch is closed.

Collapsible Canvas Bag for Linemen

A collapsible canvas bag with wooden bottom for carrying linemen's tools, insulators and other objects has been developed by the Industrial Products Company, 1001 Chestnut Street, Philadelphia. A large rope loop at the top answers the purpose of a handle, and a smaller rope at the side forms a hook for putting over an insulator pin. There are no metal parts to come in contact with live wires. The width of the bag is such that it will pass between circuits. This bag can be used for carrying material up and down the pole and also for holding tools and other implements on the crossarms

Coil Winder and Shaper

A coil winder and shaper has been developed and patented by the Palmer Electric Company, 60 Park Place, Detroit, Mich. This piece of apparatus, according to the makers, can be made to wind and shape any size of coil, from the hairpin to the diamond style, which is almost entirely used today in direct-current armatures, two-phase and three-phase stators and single-phase rotors. At present the new winder is being made in two sizes, except on special orders. The smaller size makes coils up to and including 7.5 hp., 1,700 r.p.m., and the larger one from 2 hp. to about 35 hp.

Lighting Unit with Appliance Receptacle

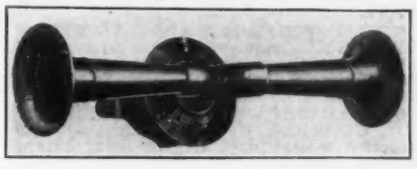
The Luminous Unit Company of the St. Louis Brass Manufacturing Company, St. Louis, Mo., is now equipping Brasscolite reflectors with a separate plug receptacle for attaching toasters, electric irons or other appliances. The receptacle is on the under side of the reflector and is intended to facilitate the use of table appliances and other electrical household equipment.

Twelve-Inch Oscillating Fan

The Pittsburgh Electric Specialties Company, 447 Greenwich Street, New York City, is offering this year a 12-in. oscillating fan, in addition to its 8-in. and 10-in. sizes. The fan is in black japan finish, with brass-finished blades, and is adjustable for desk or wall use. The motor has three-speed regulation on alternate or direct current. The fan can be used as either a straight or an oscillating device. and is equipped with cord and plug. Its shipping weight is 18 lb.

Double-Horn Factory Signal

A double-horn factory signal has been developed by the Benjamin Electric Manufacturing Company, Chicago, Ill. This signal is designed to be placed



TO BE PLACED IN CORRIDOR

in a passageway where it is desired that the sound be projected both ways along the direction of the passage. The body is cast brass and is tapped for conduit.

Ten-Step Variable Inductor

A ten-step variable inductance made by the Clapp-Eastham Manufacturing Company, 139 Main Street, Cambridge, Mass., consists of a single coil wound with a view to obtaining small distributed capacity and low resistance to high frequency currents. The ten taps are brought out to a dead-end switch to eliminate dead effects when only a portion of the coil is in use. The in-

INDUCTANCE VARIED BY TURNING THE HANDLE

ductance at 1,000 m. may be varied from 1.25 to 254 millihenries. When used with a variable condenser of 0.001 mf. it is said that all wave lengths from 1,000 m. to 30,000 m. may be obtained. It is mounted in an oak box with bakelite cover measuring 6 in. x 6 in.

MANUFACTURERS' ACTIVITIES

Record of Changes Affecting Sales and Distribution Together with Trade Personals and Notes on Foreign Trade, Jobbers' News and New Trade Literature

THE SUNBEAM ELECTRIC MANUFACTURING COMPANY, Evansville, Ind., has increased its capital stock to $275,000.

THE PRECISION INSTRUMENT COMPANY has removed its factory from Detroit, Mich., to 21 Halsey Street, Newark, N. J.

THE BLUEBIRD MANUFACTURING COMPANY, St. Louis, Mo., has increased its capital stock from $1,000,000 to $4,500,000.

THE NATIONAL INSULATING COMPANY, Lamberton, Ohio, plans to erect a new plant, 80 ft. x 216 ft., at Parkersburg, W. Va.

THE INTERNATIONAL BATTERY COMPANY, Grand Rapids, Mich., has taken over the property and holdings of the Monarch Storage Battery of Grand Rapids.

THE AMERICAN RADIO & RESEARCH CORPORATION, New York City, is constructing a new plant for the manufacture of ¼-hp. motors.

THE POWER EQUIPMENT COMPANY, 343 South Dearborn Street, Chicago, is planning to build a one-story plant, 124 ft. x 150 ft., to cost about $50,000.

THE LAPP INSULATOR COMPANY, Leroy, N. Y., manufacturer of electrical porcelain insulators, has increased its capital stock from $150,000 to $500,000 for business expansion.

THE ELECTROMECHANICAL COMPANY, 530 North Calvert Street, Baltimore, Md., will occupy a four-story building at Calvert and Franklin Streets, which is being remodeled.

THE B. & K. MANUFACTURING COMPANY, New Britain, Conn., manufacturer of portable lamps, has announced the removal of its plant to 62 Franklin Street, New Haven, Conn.

THE UNIVERSAL BATTERY COMPANY, 3410 South La Salle Street, Chicago, is planing to build a two-story plant on Wentworth Avenue, near Thirty-fifth Street, to cost about $100,000.

THE NEW ENGLAND INCANDESCENT LIGHTING COMPANY has leased the building at 258 Elizabeth Street, New York City, to be used for a new electrical specialty works.

THE UNITED STATES LIGHT & HEAT CORPORATION, Niagara Falls, N. Y., has awarded contract for an extension to its acid plant at Highland Avenue and New York Central Railroad, to cost about $50,000.

WILLIAM R. ROOT, who has been in the slate business in Virginia for a number of years, has been appointed sales manager of the American Steam Conveyor Corporation, manufacturers of ash-handling plants, Chicago.

THE NATIONAL CARBON COMPANY, Niagara Falls, N. Y., has awarded contract for construction of a one-story brick and steel furnace building, 85 x 320 ft. at its plant, to cost with equipment about $150,000.

THE AMERICAN MANUFACTURING COMPANY, Dayton, Ohio, recently incorporated with a capital stock of $100,000, has taken over the property of the Pasteur-Chamberlain Company and will manufacture washing machines.

THE AMERICAN ELECTRICAL HEATER COMPANY, 1351 Woodward Avenue, Detroit, Mich., has had plans prepared for the construction of a two-story and basement plant, 30 ft. x 130 ft., on Conner Avenue, Hamtramck, Mich.

THE STANDARD ELECTRIC TOOL COMPANY, Cincinnati, Ohio, has increased its capital stock from $40,000 to $75,000. New equipment, it is understood, will be purchased to increase its production of electric drills and grinders.

THE MOLONEY ELECTRIC COMPANY, St. Louis, Mo., has opened an office at 451 Ellicott Square Building, Buffalo, N. Y., under the management of J. Leo Scanlon, who formerly represented the company in Iowa and adjacent territory.

THE WAITE & BARTLETT MANUFACTURING COMPANY, 252 West Twenty-ninth Street, New York, N. Y., manufacturer of electrical equipment, plans to remodel a five-story building at Jackson Avenue and Fifth Street, Long Island City, for a new plant.

THE MANHATTAN ELECTRIC SUPPLY COMPANY, 17 Park Place, New York City, manufacturer of electrical specialties, has leased the building at 423 Broome Street, New York City, for ten years, which it will use for general manufacturing purposes.

THE APEX APPLIANCE COMPANY of Chicago is planning the construction of a branch plant at Oakland, Cal., to have an initial capacity of 20,000 electric washing machines annually. This company also manufactures vacuum cleaners, ironing machines and similar appliances.

THE WAGNER ELECTRIC MANUFACTURING COMPANY of St. Louis has moved its Buffalo office to 16 Carlton Street and has opened a service station at the same address. Alfred W. Baldwin, who has been connected with the company for a number of years, is in charge as branch manager.

THE DOMESTIC ELECTRIC COMPANY, Cleveland, Ohio, manufacturer of small motors, has taken over the plant of the Vahan Products Company at St. Clair Avenue and East Seventy-third Street, which it will soon place in operation. The company will retain its present quarters in the Whitney Power Block.

THE WESTINGHOUSE LAMP COMPANY, 165 Broadway, New York, N. Y., has had plans prepared for the erection of a four-story building, 80 ft. x 550 ft., at its plant in the Watsessing district of Bloomfield, N. J. The cost of the structure, including machinery and equipment, is estimated at about $1,000,000.

A. S. WINTER, formerly advertising and sales manager of the William Powell Company, has joined the sales force of the Fairbanks Company of Pittsburgh, Pa., and will represent the company in Southern Ohio. Mr. Winter's address will be 3126 Vine Street, Cincinnati, Ohio. He will handle Lincoln motors among other things.

THE UNION LAMP COMPANY, Union Hill, N. J., recently organized, plans to establish a plant to manufacture nitrogen lamps. The proposed plant will have a capacity of 2,000 lamps per day. Charles Levy, formerly sales manager of the Weehawken (N. J.) Tungsten Lamps Company, is at the head of the new company.

THE GENT-JEWETT ENGINEERING COMPANY, 12,369 Euclid Avenue, Cleveland, Ohio, was recently organized as successor to the Electro-Call Signal Company of Cleveland. The new company will retain the trade name "Electro-Call" and will continue the manufacture of Electro-Call equipment and other electrical specialties.

THE RELIABLE ELECTRIC COMPANY, Chicago, maker of lightning protection devices for telephone equipment, splicing sleeves for aërial and underground conductors and various other apparatus, has placed under construction an addition to its plant which will cost $75,000 and increase capacity by about 50 per cent.

THE AUTOMATIC ELECTRIC COMPANY, Chicago, in April will move its offices and iron and wood-working departments into a new building across the street from the old plant. The other departments will expand to the limit of space left by these departments, the effect being practically to double the company's space and capacity.

THE LANGSTADT & MEYER COMPANY, Appleton, Wis., is erecting a two-story machine shop for manufacturing self-contained electro-generating systems and is also enlarging its automotive electric service and contracting branches at Green Bay and Oshkosh, Wis. The company recently increased its capital stock from $50,000 to $400,000.

THE FOUNDATION COMPANY, Woolworth Building, New York City, has purchased the twelve-story office building at 120 Liberty Street and will occupy five floors about May 1. This will give the company use of about 18,000 sq.ft. of space at the start, which will be increased as present long leases expire. The building will be known as the Foundation Building.

THE WESTINGHOUSE UNION BATTERY COMPANY, recently organized by Westinghouse interests, is arranging for the occupancy of three floors of one of the buildings at the plant of the Union Switch & Signal Company, Swissvale, Pa., for the manufacture of electric storage batteries. A new plant, it is understood, will be built for the company at a later date adjoining the Swissvale works.

THE DRIVER-HARRIS COMPANY, of Harrison, N. J., manufacturer of electrical resistance wires, special alloys and pure metals for electrical, mechanical and chemical uses, is now putting up a three-story building, 52 ft. x 100 ft., to which will be added a 100-ft. extension. The company contemplates the erection of another large building later in the year. Its capitalization has been increased to $3,000,000.

THE WESTERN ELECTRIC COMPANY announces that it will proceed immediately with the construction at Hawthorne, Ill., of three new six-story-and-basement additions to its telephone apparatus department, aggregating 277,000 sq. ft.; a four-story and basement warehouse, to contain 150,000 sq.ft., and a small packing-material factory. The company is making additions to its branch houses in sixteen different cities.

THE GENERAL ELECTRIC COMPANY has announced the appointment of E. W. Lankenau as head of the new plant of the company at Decatur, Ill., where small motors will be manufactured and where it is expected operations will begin some time this spring. Mr. Lankenau has been connected with the Fort Wayne (Ind.) plant for a number of years and, during the past year, was assistant general foreman of the small-motor department of that plant.

THE ELECTRIC EQUIPMENT COMPANY has been formed in Boston, Mass., by John I. O'Brien and Carlton N. Merrill for the purpose of dealing in new and used electric motors and dynamos, making repairs on electrical machinery and wiring for and installing all kinds of electrical equipment. Both members of the firm have been connected with the Carl G. Miller Company of Boston many years. The company is established at 161 Summer Street, Boston.

THE H. S. WHITING COMPANY, INC., 104 East Forty-first Street, New York City, has taken over the manufacture of the lighting fixtures formerly brought out by J. Livingston & Company, Inc. The new company will manufacture and distribute the "Livingston Economy Light" (licensed under Duplexalite Corporation patents) and other commercial units, operating with practically the organization that heretofore constituted J. Livingston & Company's commercial department.

THE UTILITIES ENGINEERING & AUDIT COMPANY, Crawford Building, Topeka, Kan., has been organized for the purpose of preparing valuations and appraisal of industries and utility properties and also for making rate investigations and financial reports. John M. Kinkel, formerly chairman of the Kansas Public Utilities Commission, and Paul L. Grady, formerly acting chief engineer of the same commission, are members of the firm. Herbert B. Couch, formerly electrical engineer of the Nebraska commission, has recently joined the organization.

THE HAMILTON-BEACH CARPET WASHER COMPANY, with general offices at 114 Liberty Street, New York City, has been organized to manufacture and market the new Hamilton-Beach electrically operated carpet washer which was described on page 731 of the Sept. 27, 1919, issue of the ELECTRICAL WORLD. In its sales policy the new company will follow the Goodwin idea of distributer-dealer-consumer channels. The new rug and carpet washers are ready for immediate delivery, it is said. F. J. Osius is president of the company, and Frederick Riebel, Jr., who for ten years was connected with the Westinghouse Electric & Manufacturing Company, is general sales manager

GENERAL ELECTRIC TO BUILD PORCELAIN PLANT. The General Electric Company will build a porcelain manufacturing plant at Pittsfield, Mass., in connection with its existing works, utilizing local clay in this product. About 300 additional employees will be required when the plant is placed in operation. The estimated cost of the new plant is $250,000. The

company is now building a wire-insulating factory more than 400 ft. long at the Pittsfield works and has carried the reinforced-concrete construction work along during the recent cold weather by the application of localized heating methods. At present the demands upon these works are exceeding their capacity.

F. W. KENNEDY, formerly assistant business manager of the ELECTRICAL WORLD, resigned on March 1 to become sales manager of the Kleinschmidt Electric Company, Inc., manufacturer of automatic printing telegraph and fire alarm telegraph apparatus, Sperry Building, Manhattan Bridge Plaza, Brooklyn, N. Y. Mr. Kennedy, a 1909 electrical engineer of Columbia University, has been connected with engineering work on New York harbor fortifications, was for a year and a half with the General Motors Company as claim manager and sales engineer of its export company and truck company, and before becoming connected with the ELECTRICAL WORLD in 1914 had been assistant works manager of the Diehl Manufacturing Company, Elizabeth, N. J.

THE AMERICAN STEAM CONVEYOR CORPORATION, 326 West Madison Street, Chicago, Ill., announces the appointment of the Kon-Wald Engineering Company, Buffalo, N. Y., as its representative in Buffalo and western New York. F. A. Konzelman is manager of the latter company. The Brooks-Fisher Company, Atlanta, Ga., has been appointed Southeastern representative of the American Steam Conveyor Corporation. The Brooks-Fisher Company was organized last summer to carry on the business of manufacturers, agents and contractors. J. M. Fisher was for fifteen years in the erection department of the Babcock & Wilcox Company, and for the last six of these years he was district superintendent for the Atlanta territory. E. A. Brooks, the other member of the firm, was up to the time of the organization of the company, assistant sales manager for the Atlanta office of the Babcock & Wilcox Company.

Supply Jobbers' Notes

THE WESTERN ELECTRIC COMPANY has recently established a new warehouse at Nashville, Tenn., to serve from that city all the territory in Tennessee formerly assigned to Cincinnati. Karl B. Mayer, formerly with the Dallas house, is store manager of the new warehouse.

THE ACME STORAGE BATTERY CORPORATION, Poughkeepsie, N. Y., has changed its principal product from house-lighting batteries to starting and lighting batteries of the automobile type. The capital stock of the company was recently increased from $100,000 to $175,000.

FREDERICK RALL, manufacturers' agent of electrical appliances, 19 Park Place and 16 Murray Street, New York, N. Y., about May 1 will move to 38 Murray Street. At the new location he will have double the floor space provided at the present quarters and will carry a complete stock of the products of the O. C. White Company of Worcester, Mass.; the Trumbull Vanderpoel Electric Manufacturing Company, of Bantam, Conn., and the Jewell Electrical Instrument Co. of Chicago, Ill. With increased space Mr. Rall is negotiating for additional accounts.

THE COMMERCIAL ELECTRIC COMPANY, 42-50 East Congress Street, Detroit, Mich., through F. W. Woolrich, president, announces its decision to discontinue a certain part of its regular jobbing business, and in the future it will confine its efforts and sales to the following: Westinghouse products, including motors, fans, ranges and heating appliances; Hamilton-Beach products, "Economy" renewal fuses Westinghouse lamps, Cutter material, lighting specialties such as "Brascolites," "Industrolites," "Aglites," X-ray reflectors and Cutter "Sol-lux" industrial lighting fixtures; Bluebird electric clothes washers, Roma ironing machines, Free-Westinghouse sewing machines, vacuum cleaners, dishwashers and other household electrical appliances. At the present time the company catalogs and carries in stock about 500 different items. Under the new management it will reduce its lines to about twenty commodities. The new policy of the company will definitely establish a basis of wholesale distribution only, and both dealers and contractors will have the assurance that nothing will be sold at retail nor will any counter trade be permitted. No broken package orders will be accepted.

Foreign Trade Notes

THE CANADA WEST ELECTRIC COMPANY, 1221 Osier Street, Regina, Saskatchewan, contemplates improvements to its plant, to cost about $40,000.

THE CANADIAN GENERAL ELECTRIC COMPANY, it is reported, will expend between $600,000 and $1,000,000 on extensions to its plant at Peterborough, Ontario, including buildings and equipment. Construction work is expected to begin in June. The company is asking the city for a ten-year extension of its present fixed assessment of $150,000.

PROPOSED EXTENSION OF HYDRO-ELECTRIC PROJECTS IN JAPAN.—Commercial Attaché James F. Abbott, Tokyo, Japan, reports that the proposed extension of hydro-electric projects in Japan will involve the building of about 1,000 miles of high-tension transmission lines within the next two years, the most of which, it is reported, will probably be of the steel-tower type.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A firm in Spain (No. 32,127) desires to secure agencies for the sale of electrical materials.

A firm in India (No. 32,242) desires to purchase and secure an agency for electrical goods.

A commercial agent in Italy (No. 32,162) desires to secure an agency for the sale of electric meters.

A firm in China (No. 32,137) desires to get in touch with manufacturers of electric wire or machinery for making electric wire.

An engineering firm in New Zealand (No. 32,271) desires to secure an agency for the sale of electric generators, motors and supplies.

A firm of contractors and engineers in Siberia (No. 32,136) is desirous of getting in touch with manufacturers of electrical equipment, telephones, etc.

An importing firm in India (No. 32,297) desires to be placed in communication with merchants and manufacturers of electrical goods with a view to securing sole agencies.

An importing firm in England (No. 32,125) desires to purchase from manufacturers ebonite moldings for electrical work, especially telephone handles. Drawings of the handles were forwarded and may be examined at the bur au or its district offices. (Refer to file No. 21,771.)

Trade Publications

ELECTRICAL INSTRUMENTS. — The Roller-Smith Company, 233 Broadway, New York, has issued a small pamphlet describing electrical instruments, circuit breakers and meters.

DRY BATTERIES.—Bulletin 7 of the Burgess Battery Company, Madison, Wis., describes the dry batteries of different types, including sets composed of a number of batteries in one box.

POLYPHASE MOTORS.—Bulletin 122 issued by the Wagner Electric Manufacturing Company, St. Louis, Mo., describes starterless squirrel-cage motors and wound-rotor polyphase induction motors.

VENTILATING FANS.—The Sprague Electric Works, 527 West Thirty-fourth Street, New York City, have issued a small booklet on ventilating fans driven by direct-current and alternating-current motors.

AIR-CIRCUIT BREAKERS.—The General Electric Company has issued bulletin 47,520, describing type CG air-current breakers, which are used on direct current up to 300 amp. and 500 volts and on alternating current up to 300 amp. and 600 volts.

STEAM TABLES.—The Wheeler Condenser & Engineering Company, Carteret N. J., announces the publication of the 1920 edition of their "Steam Tables for Condenser Work." The book gives the properties of saturated steam from 29.8 vacuum to atmospheric pressure in increments of tenths of an inch, besides regular tables for pressures above atmospheric.

CENTRIFUGAL PUMPS.—In a pamphlet entitled "High-Efficiency Centrifugal Pumps" the De Laval Steam Turbine Company of Trenton, N. J., has described official tests made by the city of Minneapolis upon a 20-in. De Laval centrifugal pump driven by an induction motor and similar tests made by the city of St. Paul upon two 12-in. De Laval centrifugal pumps driven by synchronous motors.

New Incorporations

THE TAPPEN ELECTRIC COMPANY of Lima, Ohio, has been incorporated with a capital stock of $15,000 by L. B. Morehouse and C. L. Tappen.

THE PRIMA ELECTRIC SHOP COMPANY of Toledo, Ohio, has been incorporated with a capital stock of $10,000 by E. F. Chittenden and C. H. Steele.

THE TRAVIS ELECTRIC COMPANY of San Antonio, Tex., has been incorporated with a capital stock of $10,000 by Fred Krisch, J. E. Smith and J. H. Cunningham.

THE MASON HALLS LIGHT & WATER PLANT of Mason, Tenn., has filed articles of incorporation with a capital stock of $3,000. The incorporators are J. H. Wood, J. H. Sawyer and J. A. Hollman.

THE CENTRAL ELECTRIC COMPANY of Anderson, Ind., has been incorporated with a capital stock of $5,000 by Lee Longfellow, Ray Thornsburg and Clyde Culbertson. The company proposes to operate an electric plant.

THE THERMO-ELECTRIC COMPANY of Los Angeles, Cal., has been incorporated with a capital stock of $250,000 by Frank L. Burns, W. E. Tipton and Theodore Stensland. The company proposes to manufacture electrical apparatus.

THE ASTORIA (ORE.) ELECTRIC COMPANY has been incorporated by F. C. Green, E. P. Steele and A. W. Norblad. The company is capitalized at $10,000 and proposes to do a general electric contracting, construction and engineering business.

THE ORANGE COUNTY PUBLIC SERVICE COMPANY of Orleans, Ind., has been incorporated with a capital stock of $75,000 to supply water, heat and power. The incorporators are George H. Carter, Ralph M. Jenkins and Oliver W. Stephenson.

THE DENLINGER LAMP & IGNITION COMPANY of Syracuse, N. Y., has been incorporated by C. J. Bennett, F. A. Brown and M. G. Denlinger. The company is capitalized at $12,000 and proposes to manufacture ignition equipment and automobile accessories.

THE BIG FOUR BATTERY COMPANY of Hammond, Ind., has been incorporated with a capital stock of $30,000 by Charles N. Nau, Felix J. Nau, William F. Ryan, Leland L. Wicker, Fred W. Dempsey and Leo F. Carroll. The company proposes to manufacture storage batteries.

THE POLLACK CONDUIT & ELECTRICAL SUPPLY COMPANY of New York, N. Y., has been incorporated with a capital stock of $20,000 to manufacture electrical conduits and equipment. The incorporators are L. Pollack and M. Simon, 205 Twenty-fifth Street, New York, N. Y.

THE SKINDERVIKEN ELECTRICAL COMPANY of New York, N. Y., has been chartered with a capital stock of $35,000 by J. Skinderviken, H. E. Goldsmith and M. Moskowitz, 1265 Broadway, New York City. The company proposes to manufacture telephone and telegraph apparatus.

THE L. & N. STORAGE BATTERY COMPANY of Louisville, Ky., has been incorporated with a capital stock of $50,000 to manufacture storage batteries and other electric equipment. The incorporators are M. Y. Middleton of Louisville, John U. Field and George E. Goodwin of Lexington, Ky.

THE COMMONWEALTH BATTERY COMPANY, 17 Elm Street, Rochester, N. Y., has been incorporated with a capital stock of $50,000 to manufacture plates for storage batteries, supplying service stations in preparing these batteries. The officers are J. Harris, president and general manager; G. H. Van Blaricum, vice-president, and Linus Heberger, secretary and treasurer.

New England States

NEW BEDFORD, MASS.—The New Bedford Gas & Edison Light Company plans additions and improvements to its plant to cost about $2,000,000. Eight boilers, with a capacity of 20,000 hp. and a 20,000-kw. turbine will be installed.

ROXBURY, MASS.—The Tremont Manufacturing Company plans to build a new substation.

PROVIDENCE, R. I.—The General Electric Company has taken over the plant of the D. & W. Fuse Company in Auburn and plans extensive improvements. L. W. Downes is manager.

BRISTOL, CONN. — The Chamber of Commerce is considering an improved street-lighting system for the business center of the city.

MERIDEN, CONN.—The Connecticut Telephone & Electric Company contemplates an addition to its Britannia Street plant, involving an expenditure of about $300,000.

NEW BRITAIN, CONN.—The New Britain Children's Home, 81 Garden Street, is having plans prepared by W. P. Crabtree, architect, 272 Main Street, for a new 3-story school and home on Rockcliffe Heights, to cost about $350,000. Considerable electrical equipment will be required.

Middle Atlantic States

BLACK RIVER, N. Y.—The St. Regis Paper Company of Watertown is having plans prepared for power house and 9,000-hp. hydroelectric development on Black River.

BROOKLYN, N. Y.—The Flatbush Gas Company contemplates the erection of seventy-two 13,200-volt feeder lines. H. E. McGowan is secretary.

CHEEKTOWAGA, N. Y.—The capital of the Depew & Lancaster Light, Power & Conduit Company has been increased from $500,000 to $1,250,000.

FAR ROCKAWAY, N. Y.—The Queensborough Gas & Electric Company will erect an addition to its generating station to provide for the installation of two additional 600-hp. boilers. C. Macy is manager.

GENEVA, N. Y.—The Empire Coke Company contemplates extensive improvements in its local plant, including the installation of a carbureted water gas plant, a new boiler and power plant and an additional gas compressor. The total cost is estimated at $263,885. E. H. Palmer is president.

HADLEY, N. Y.—The Hadley Light & Power Company contemplates the construction of an addition to its local plant.

NEW YORK, N. Y.—The New York Telephone Company, 15 Dey Street, is having plans prepared by McKenzie, Voorhees & Grelin, 1123 Broadway, for construction of an automatic telephone exchange on West Seventy-third Street, to cost about $1,540,000.

NEW YORK, N. Y.—The New York & Queens Electric Light & Power Company will erect three transmission cables, one from the plant of the United Electric Light & Power Company, Manhattan, and two between Flushing and Jamaica. H. C. Dean is general superintendent.

NEW YORK, N. Y.—The United Electric Light & Power Company contemplates the installation of a 22,000-kw. turbo-generator, the erection of a 300,000-kw. generating station, and changing its transmission voltage in all stations, from 7,500 volts to 15,000 volts. F. W. Smith is manager.

OLD FORGE, N. Y.—The construction of a municipal lighting plant and waterworks system is under consideration, to cost from $150,000 to $200,000. Maurice Callahan, president First National Bank, is reported interested.

TUCKAHOE, N. Y.—A power plant will be erected in connection with the construction of the proposed new six-story plant of the Hodgman Rubber Company on Scarsdale Avenue.

WALDEN, N. Y.—The Walkill Valley Electric Light & Power Company has increased its capital from $30,000 to $50,000.

ESSEX FALLS, N. J.—The Central & South American Telephone Company, 89 Broad Street, New York, N. Y. contemplates the erection of a local plant for the manufacture and repair of cable instruments.

JERSEY CITY, N. J.—The City Commission will soon receive bids for the construction of a power house and installation of mechanical equipment for the Jersey City Hospital building. The cost will exceed $50,000.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

JERSEY CITY, N. J. — The Whitlock Cordage Company, Communipaw Avenue, is having plans prepared for a one-story power plant in which turbines, four 400-hp. boilers, etc., will be installed, in connection with the construction of a new four-story addition to its plant.

TRENTON, N. J.—Plans are being prepared by J. R. Fell, engineer, City Hall, for the installation of arc lamps and fixtures in Stacy Park. G. W. Page, City Hall, is in charge of the lighting system.

CHESTER, PA.—The Chester Hospital will require considerable electrical equipment in connection with the construction of the proposed new surgical building.

ERIE, PA.—The Skinner Engine Company, Twelfth and Chestnut Streets, is having plans prepared by A. F. Shotte, Marine Bank Building, for extensive improvements and additions at its plant, including a new power plant and a shop building to cost about $80,000.

PHILADELPHIA, PA. — The General Electric Company, it is reported, plans to construct a new plant in the southwestern part of the city. The project includes five manufacturing buildings and auxiliary structures, to cost over $5,000,000.

READING, PA.—Plans are under consideration by the city officials for improvements and alterations in the Maiden Creek pumping station of the municipal waterworks plant. D. E. Dampman, superintendent of parks and public property.

BALTIMORE, MD.—The Maryland Casualty Company will require large quantities of electrical and mechanical equipment, including motors for individual drive, in connection with the new administration building and printing plant to be erected at Fortieth Street and Cedar Avenue, to cost about $1,500,000.

DENTON, MD.—The Town Council contemplates the erection of a new municipal electric light and power plant, to cost about $40,000.

HAMPTON ROADS, VA.—Plans are being prepared in Commander McKay's office, Bureau of Yards and Docks, Washington, D. C., for construction of underground electric distributing system at the local naval operating base.

WARRENTON, VA. — The Warrenton Electric Light & Power Company contemplates the installation of one 90-kw., 2,200-volt, 60-cycle generator, one 150-hp. Erie boiler and the erection of 5 miles transmission lines. M. J. O'Connell is manager.

North Central States

BAD AXE, MICH.—N. J. Frost and others contemplate the construction of a completely equipped electric power plant to supply the city of Bad Axe and surrounding territory.

DETROIT, MICH.—The Hannan Real Estate Exchange, 1 McGraw Building, plans to erect a commercial building, five stories, at Woodward Avenue and Sibley Street, at a cost of about $200,000, for which considerable electrical equipment will be required.

DETROIT, MICH. — Bids will soon be asked by the City Water Board for construction of a new booster pumping station at Waterworks Park, for which five electrically driven centrifugal pumping units will be needed. The cost is estimated at $100,000. T. A. Leiser, 232 Jefferson Avenue, is engineer.

FLINT, MICH.—The Flint Medical Society, Detroit Street, contemplates the erection of a five-story office building at Fourth and Detroit Streets, to cost about $200,000. Considerable electrical equipment will be required.

FLINT, MICH.—The Knights of Columbus, P. Callahan, chairman, plan to build a new three-story clubhouse, in connection with which considerable electrical equipment will be required, at an approximate cost of $250,000. Van Leyen, Schillin, Keough & Reynolds, Union Trust Building, Detroit, are the architects.

HIGHLAND PARK, MICH.—The Detroit Osteopathic Hospital, care of P. H. Gray, Highland Park, will require equipment for electric lighting and elevator control in connection with new five-story hospital to be erected at Highland and Third Avenues, at a cost of about $250,000.

HILLSIDE, MICH.—At an election to be held April 5 the proposal to issue $60,000 in bonds for improvements to the municipal power plant will be submitted to the voters.

IRONWOOD, MICH.—Plans are being prepared by Alvord & Burdick, engineers, 8 South Dearborn Street, Chicago, Ill., for extensions to the municipal waterworks system and installation of electrical pumping equipment. The cost is estimated at $300,000.

JACKSON, MICH.—The Michigan Light & Consumers' Power Company contemplates the erection of a substation and a single line steel-tower transmission line to Battle Creek. The cost is estimated at $410,000.

MANISTIQUE, MICH.—The construction of a new municipal pumping station will be necessary in connection with a new power contract approved by the Board of Public Works.

PONTIAC, MICH.—The Grand Trunk Railway System, Brush Street, Detroit, contemplates the construction of a roundhouse to have a fifty-engine capacity and will require complete electric light and power equipment. F. P. Sissons is division engineer.

CLEVELAND, OHIO.—The Board of County Commissioners, Court House, Cleveland, contemplates the erection of a new heating plant at Lakeside Avenue and West Third Street. The cost is estimated at $250,000. E. S. Krause is clerk.

CLEVELAND, OHIO.—Considerable electrical equipment will be required for the proposed new school building to be erected on St. Clair Avenue, by St. Joseph's Church. The estimated cost is $300,000. C. Greco Guardian Building, is architect. For further information address Rev. J. W. Bell, 14,422 Aspinwall Avenue.

DAYTON, OHIO.—The Allsteel Ridewell Tire & Rubber Company, Lindsey Building, contemplates the purchase of complete electrical equipment for power plant to be erected in connection with its new factory, for which building contract was recently awarded to the Osborn Engineering Company, 2848 Prospect Avenue, Cleveland. The total estimated cost is $100,000.

MARION, OHIO—The Columbus, Delaware & Marion Traction Company plans the erection of a power plant to cost about $500,000 at Newmans, 7 miles south of this city, and also a three-story terminal station and loop in Marion.

MARYSVILLE, OHIO.—The Marysville Light & Water Company contemplates the installation of an additional boiler and turbine. M. Mackan is superintendent.

MIAMISBURG, OHIO.—The installation of a gas-engine-driven generating unit in the municipal water and light plant is under consideration, to cost about $30,000. A. W. Kepler is superintendent.

ST. BERNARD, OHIO.—The Union Gas & Electric Company is contemplating the purchase of the municipal electric plant and also to install centrifugal pumping equipment in the waterworks plant, to cost about $15,000. The price offered for the municipal plant is $50,000.

SPRINGFIELD, OHIO.—The Dale Electric Company has increased its capital stock from $10,000 to $50,000.

HAZARD, KY.—The Hazard Light & Power Company has increased its capital stock from $50,000 to $200,000, and plans immediate extensions and improvements.

WHITESBURG, KY.—The Whitesburg Light & Power Company contemplates various improvements this spring. H. C. Daniel is manager.

CONNERSVILLE, IND. — The Hydro Electric Light & Power Company has increased its capital stock from $750,000 to $1,125,000.

GREENFIELD, IND.—The City Council has authorized the construction of a transmission line to connect the municipal electric plant with that of the Indianapolis Light & Heat Company, Indianapolis, for the purpose of supplying Greenfield with energy. The cost is estimated at $60,000.

CHICAGO, ILL.—The Alemite Die Casting & Manufacturing Company, 341 West Chicago Avenue, is having plans prepared by R. C. Ostergren, architect, 155 North Clark Street, for the proposed new factory building, to cost about $250,000. Considerable electrical equipment will be required.

BELLEVILLE, WIS. — The Belleville Electric Company plans the erection of additional rural transmission lines. W. E. Seward is superintendent.

KOHLER, WIS.—The Council is considering calling an election to submit to the voters the proposal to issue $12,000 in bonds for construction of a municipal electric lighting system. J. Donahue of Sheboygan is engineer.

MADISON, WIS.—The State Board of Control, Capitol Building, contemplates the erection of a new power plant in Capitol Square to cost about $18,415.

MANITOWOC, WIS. — The Aluminum Goods Manufacturing Company is having plans prepared by L. Greene & Company, engineers, South Dearborn Street, Chicago, for construction of a two-story rolling mill to cost about $500,000. Electrical power and wiring equipment will be required.

MARSHFIELD, WIS.—The Roddis Lumber & Veneer Company of Marshfield is having plans prepared by Cahill & Douglas, 217 West Water Street, Milwaukee, for a power house. A generating unit and boilers will be installed.

MILWAUKEE, WIS.—Bids are now being receivd by A. S. Hecht, architect, 640 West Randolph Street, Chicago, Ill., for construction of the new four-story, terminal for the Chicago, Racine & Milwaukee Railroad, Broadway and Erie Streets, Milwaukee. The estimated cost is $750,000.

TOMAHAWK, WIS.—The Pride Pulp & Paper Company, recently organized, contemplates the construction of a pulp and paper mill, a sulphate-fiber mill and hydroelectric power developments at Grandmother Falls and Nigger Island, on the Wisconsin River, near here. The entire project will entail an expenditure of about $3,500,000. C. B. Pride is president.

WAUKESHA, WIS. — The Waukesha Foundry Company plans to install an overhead trolley system in its proposed new plant. The total cost is estimated at about $40,000.

BENSON, MINN.—The city officials are considering improvement and alterations in the municipal electric light plant, to cost about $40,000. T. B. Lee is superintendent.

MINNEAPOLIS, MINN. — The Russell Grader Manufacturing Company, 203 University Avenue, S. E., contemplates the construction of a power house and office building, with complete electrical equipment, in connection with proposed new grader factory on Kennedy Street, near Stinson Boulevard. The cost will be about $250,000.

DES MOINES, IOWA.—The Iowa Telephone Company (Bell System) Seventh and High Streets, will require complete electrical equipment in connection with the construction of the proposed three-story building it plans to erect at a cost of about $300,000. G. B. Prinz, Omaha National Bank Building, is architect.

ST. LOUIS, MO. — The Union Electric Light & Power Company contemplates the erection of an outdoor transformer station on Lewis Street.

FESSENDEN, N. D. — The Fessenden Light & Power Company contemplates the installation of one 200-hp. generating unit and extension of its transmission lines. H. O. Whitcomb is manager.

FORDVILLE, N. D.—The Fordville Garage & Light Company contemplates the installation of one 25-hp. oil engine and a generator. C. R. Thol is manager.

NEW ROCKFORD, N. D.—Bids will be received until further notice by C. L. Pillsbury Company, engineer, Metropolitan Life Building, Minneapolis, Minn. for furnishing and installing a 75-kw. generator and engine in the power plant of the General Utilties Corporation.

WHITE LAKE, S. D.—The White Lake Light & Power Company contemplates the extension of its transmission lines. V. J. Peters is manager.

SUTTON, NEB.—Extensions to the municipal electric transmission system are contemplated. H. H. Bauer is commissioner of light and water.

HARVEYVILLE, KAN.—Bonds to the amount of $10,000 have been voted for the construction of a municipal electric lighting and power plant.

TOPEKA, KAN.—The Atchison, Topeka & Santa Fé Railway Company, 80 East Jackson Building, is having plans prepared by J. Yonkers, supervising architect, Park Building, Chicago, Ill., for construction of a central heating plant for which considerable electrical equipment will be required. The cost is estimated at about $85,000.

Southern States

GRAHAM, N. C.—Bids will soon be recieved for construction of a sewerage system with two pumping stations equipped with motor-driven centrifugal pumps. Norcross & Keis, Atlanta, Ga., are engineers.

MORAVIAN FALLS, N. C.—The Moravian Falls Milling & Power Company contemplates the installation of a new turbine. L. C. Humphries is manager.

JACKSONVILLE, FLA.—The City Commission has plans under consideration for extensions to street-lighting system. Cost is estimated at $23,500.

GREENFIELD, TENN.—Surveys are being made by A. Jenks, engineer of Union City, in connection with the proposed new municipal light plant. The cost is estimated at about $50,000.

KINGSPORT, TENN.—Kingsport Utilities, Inc., contemplates the erection of a substation and transmission lines supplying all city circuits.

PAWNEE, OKLA.—An election will be held April 6 to vote on an issue of $100,000 in bonds for the improvement to the municipal electric light plant and water system.

PONCA CITY, OKLA.—The installation of a 1,000-hp. oil engine in the municipal electric light and water plant is under consideration. P. R. Dunton is superintendent.

POTEAU, OKLA.—The Leflore Gas & Electric Company will install an additional generator and one 100-hp. boiler in its plant. F. E. Baird is manager.

RED FORK, OKLA.—The Sunlight Carbon Company contemplates the construction of a new plant to cost about $100,000.

ARCHER, TEX.—The construction of a new municipal electric light plant in Archer is under consideration. A. Minnich is manager.

BROWNWOOD, TEX.—Bonds to the amount of $150,000 have been voted for the erection of a municipal electric lighting plant, street improvements, etc.

CANADIAN, TEX.—The Canadian Water, Light & Power Company will install additional engines and extend its transmission lines. E. Hoover is manager.

CLARENDON, TEX. — The Clarendon Light & Power Company, recently organized with a capital stock of $200,000, will erect an electric lighting and power plant.

DENISON, TEX.—At an election to be held on April 6 the proposal to issue $244,000 in bonds for municipal improvements, including an electric lighting system in the downtown section and purchase of electrical pumping equipment for city reservoir, will be submitted to the voters.

LEWISVILLE, TEX.—The plant of the Lewisville Electric Light & Power Company, has been purchased by S. Cunningham. The new owner contemplates improvements, including the installation of additional machinery, to cost about $6,000.

Pacific and Mountain States

EVERETT, WASH.—At an election to be held this spring the proposal to issue bonds for construction of a new municipal electric plant and street-lighting system will be submitted to the voters.

EL CENTRO, CAL.—The Chamber of Commerce is urging an election to vote on a $165,000 bond issue for improvements to the municipal water and lighting system, installation of a fire-alarm system, and the erection of a City Hall.

INGLEWOOD, CAL.—Bids will soon be received by the Board of Trustees, J. H. Kew, city clerk, for furnishing centrifugal booster pumps of 400 to 1,200-gal. capacity. Olmstead & Gelleden, Hollingsworth Building, Los Angeles, are engineers.

LONG BEACH, CAL.—Bids are now being received by the Southern California Edison Company for furnishing and installing a 30,000-kw. horizontal steam turbine in its local plant.

LOS ANGELES, CAL.—The State Railroad Commission has authorized the Southern California Edison Company to issue $4,500,000 in capital stock for additional hydro-electric developments, etc.

LOS ANGELES, CAL. — The Southern California Edison Company announces that it is going to proceed at once with the construction of a power plant on Big Creek, to be known as Big Creek plant No. 8, which will be below the present Big Creek plant No. 2 and will utilize water formerly intended to pass through Big Creek No. 3. A tunnel has been driven below Big Creek No. 2 as part of the proposed development of Big Creek No. 3. The present plan is to break out from this tunnel and install a penstock for Big Creek No. 8, after which the water will again be taken in a tunnel through the mountain and dropped down through the Big Creek plant No. 3. Big Creek No. 8 will have a capacity of 22,500-kw. and during the year 1921 is expected to generate 100,000,000 kw.-hr. In addition to this development the Southern California Edison Company is making active progress on the impounding of water in Shaver Lake, which will be capable of supplying 46,000,000 kw.-hr. during the year 1921, to be generated in Big Creek No. 2 and Big Creek No. 8.

YUBA CITY, CAL.—Bids will soon be asked by the Reclamation District No. 1,660, P. H. McGrath, Clerk, California Fruit Building, Sacramento, for construction of levees, canals, pumping plants, etc., to cost about $1,800,000. J. C. Boyd, 803 Forum Building, Sacramento, is engineer.

GLENDALE, ARIZ. — Bonds to the amount of $20,000 have been voted for extensions and improvements to the municipal electric lighting system. Harry Hancock is city engineer.

RONAN, MONT.—The Mission Valley Electric Company has applied for permission to divert the waters of Crow Creek, near Ronan, for power purposes in connection with its proposed hydro-electric development.

KENO, ORE.—The Keno Power Company plans installation of an 800-hp. turbogenerator and the construction of a 6-mile transmission line. W. Kerns is manager.

SCIO, ORE.—Bonds to the amount of $40,000 will be issued for the construction of the proposed new light, power and pumping plant at Thomas Creek. A. Cunningham is engineer.

TILLAMOOK, ORE.—The Coast Power Company is considering the installation of a 1,000-kw. turbine. C. J. Edwards is manager.

WASCO, ORE—Steps have been taken by citizens to organize a company to be known as the Sherman Electrical Company for the purpose of erecting a transmission line to connect with the White River plant of the Pacific Light & Power Company of Los Angeles, Cal.

Canada

CALGARY, ALTA. — Additional boilers are to be installed in the municipal electric light and power plant. R. A. Brown is general superintendent.

PINCHER CREEK, ALTA. — Improvements are contemplated to the municipal electric plant, including the installation of a switchboard and rebuilding five blocks of pole transmission line. A. Langstaff is superintendent.

RED DEER, ALTA.—The Western General Electric Company, contemplates the installation of a new generating unit. W. A. Moore is manager.

OXFORD, N. S.—The Oxford Electric Light & Power Company contemplates the erection of 26 miles of transmission lines. S. D. Downing is manager.

YARMOUTH, N. S. — The Yarmouth Light & Power Company, contemplates the installation of a 750-kva. hydro-electric unit. D. R. Stoneman is secretary.

COBOURG, ONT. — The Hydro-Electric Power Commission of Ontario, Toronto, is considering plans for the construction of a 35-mile radial railroad from Cobourg to Campbellford, to cost approximately $2,500,000. F. A. Gaby, Hydro-Electric Power Company Building, Toronto is engineer.

HAWKESBURY, ONT. — The Hawkesbury Electric Light & Power Company, contemplates the installation of a 2,500-hp. waterwheel and a 2,000-kva. generator. J. Ross is manager.

NIAGARA-ON-THE-LAKE, ONT. — Improvements are contemplated by the local Hydro Commissions to the municipal electric distribution system, including erection of new poles, wires, etc.

PORT DOVER, ONT.—Plans are being prepared by E. A. James Company, Ltd., 36 Toronto Street, Toronto, for new waterworks system. Centrifugal pumps will be installed. The cost is estimated at $100,000.

SARNIA, ONT.—The Sarnia Gas & Electric Light Company plans the erection of several miles of transmission lines. J. E. B. Phelps is manager.

ARCOLA, SASK.—The Arcola Light & Power Company contemplates the installation of a 30-hp. engine and a 2,200-volt motor. H. F. Roberts is manager.

(Issued March 9, 1920.)

14,816 (Reissue). METHOD FOR CONTROLLING THE EFFICIENCY OF MERCURY RECTIFIERS; William Tschudy, Port Huron, Mich. App. filed July 4, 1916. Reduces resistance and regulates power consumed in compartment of gas or vapor electric apparatus.

1,332,879. ELECTRIC TOASTER; Bernhard M. Beskow, Lake George, N. Y. App. filed Oct. 7, 1919. Two adjustable sections between which meats are broiled.

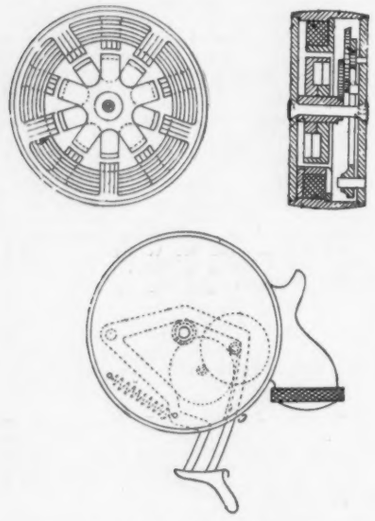
1,332,891. TROLLEY WHEEL; William R. Fearn, Camden, N. J. App. filed Feb. 27, 1919. Lessens friction on curves and facilitates passage of trolley over crossings.

1,332,935. ELECTRIC TOASTER; Mary A. Thomas, New York, N. Y. App. filed July 11, 1919. Two link-connected adjustable members.

1,332,951. TRANSMITTER; Thomas R. Purman, Washington, Pa. App. filed Feb. 12, 1918. Mercury-cup adapted to receive platinum and contact plunger-pin.

1,332,961. SIGNALING SYSTEM; De Witt C. Tanner, Glen Ridge, N. J. App. filed June 6, 1918. Switches and sending distributer for storing up impulses pending transmission.

1,332,976. SIGNALING SYSTEM; Andrew D. Dowd, Hoboken, N. J. App. filed June 6, 1918. Impulse storage devices permitting selective actuation of switches.



No. 1,333,119. Hand Generator

1,333,000. SYNCHRONIZING SYSTEM; Charles G. Spencer, East Orange, N. J. App. filed Jan. 4, 1918. For synchronous multiplex telegraphy and switching systems for control of remote signals.

1,333,003. OUTLET BOX; William A. Titus, Chicago, Ill. App. filed Jan. 22, 1917. Double socket outlet attached to power feeder for temporary use in extending taps to any desired position.

1,333,014. SIGNALING SYSTEM; Joseph C. Field, Orange, N. J. App. filed Aug. 19, 1918. Selective devices at local stations controlled over single-line circuit from central station for transmission of telegraph messages without interference.

1,333,026. TELEPHONE SYSTEM; Alben E. Lundell, New York, N. Y. App. filed Dec. 27, 1916. Trouble-indicating signals which render apparatus unselectable until abnormal condition is relieved.

1,333,027. TELEPHONE-SWITCH CONTROLLING SYSTEM; Alben E. Lundell, New York, N. Y. App. filed April 12, 1917. Controls change-over from one selective operation to next.

1,333,036. TUNGSTEN CRUCIBLE AND METHOD OF MAKING AND USING SAME; James H. Robertson and David Jankower, New York, N. Y. App. filed July 14, 1919. Pressure and heat applied in forming crucible made from commercial tungsten.

1,333,046. LIGHT SIGNAL; Herbert B. Taylor, Westfield, N. J. App. filed July 25, 1918. Almost frictionless mechanism gives three indications.

Record of Electrical Patents

Notes on United States Patents

1,333,058. ALTERNATING-CURRENT RELAY; Eli J. Blake, Westfield, N. J. App. filed April 19, 1917. Induction type having a non-magnetic cup rotor acted upon by a shifting field.

1,333,077. ELECTRIC LANTERN; Thomas H. Jackson, Philadelphia, Pa. App. filed April 25, 1919. One-cell portable flashlight.

1,333,080. ELECTRIC HEATING APPARATUS FOR METAL-WORKING MACHINES; Frank P. Kobert, Amityville, N. Y. App. filed April 5, 1917. For electric riveting and welding machines.

1,333,081. ART OF METAL WORKING; Frank P. Kobert, Amityville, N. Y. App. filed Oct. 21, 1916. Power press for forging, upsetting and welding.

1,333,095. ART OF THE TRANSMISSION OF ELECTRICAL POWER WITHOUT WIRES; Charles H. Roe, Weidman, Mich. App. filed Aug. 1, 1918. Principle of resonance in circuits wherein currents are propagated by conduction.

1,333,111. IMPEDANCE EQUALIZER FOR USE WITH TRANSFORMERS; Ray S. Hoyt, Brooklyn, N. Y. App. filed Jan. 17, 1918. Impedance of primary circuit independent of frequency and equal to impedance of the secondary circuit multiplied by transformer ratio.

1,333,117. RINGING AND LISTENING KEY; Albert Klay, Chicago, Ill. App. filed June 23, 1915. Standard cams used for all different functioned keys.

1,333,119. HAND GENERATOR; Karl K. Krag-Moller, Frederiksberg, Denmark. App. filed June 5, 1918. Pocket flashlight of flat cylindrical shape.

1,333,182. PLURAL LAMP SOCKET; Frank W. Minor and Robert H. Wood, Richmond, Va. App. filed Feb. 8, 1919. Economizes on space and eliminates danger of breakage should socket be dropped to floor.

1,333,190. INDICATOR; William F. Smith and Edwin P. Sanford, Flint, Mich. App. filed May 16, 1916. Current for operating rollers taken from trolley.

1,333,240. ELEVATOR SIGNALING SYSTEM; Franz A. Boedtcher, Bergenfield, N. J. App. filed Aug. 13, 1915. Automatic threshhold illuminating circuits.

1,333,247. ELECTROMAGNET; George C. Cummings, East Orange, N. J. App. filed May 1, 1919. Eliminates residual magnetism in oscillating relay arranged along face of polar end of magnet.

1,333,273. ELECTRIC WELDING; Thomas E. Murray, Jr., Brooklyn, N. Y. App. filed May 2, 1919. Equalization or variation of current distribution at joint.

1,333,274. APPARATUS FOR ELECTRICALLY WELDING THE SECTIONS OF A HOLLOW OBJECT; Joseph B. Murray and Thomas E. Murray, Jr., Brooklyn, N. Y. App. filed Sept. 18, 1919. Supports thin metal from within sections and on opposite sides of welding joint.

1,333,275. METAL-INCASED TUBE AND METHOD OF PRODUCING THE SAME; Thomas E. Murray, Jr., and Joseph B. Murray, Brooklyn, N. Y. App. filed Oct. 8, 1919. Casing united by electrical welding after tube is introduced.

1,333,295. STORAGE CELL; Rudolphe Drambourg, Brooklyn, N. Y. App. filed Nov. 27, 1918. Plates arranged radially.

1,333,298. SOUND EMITTER; Sydney Evershed and Willie D. Kilroy, Chiswick, London, Eng. App. filed May 3, 1910. Intensive sound waves convey messages by Morse code signaling.

1,333,311. PROCESS OF SCORING METAL; Herman A. Holz and Frank P. Fahy, New York, N. Y. App. filed March 21, 1918. Rotating disk to fuse particles of metal.

1,333,331. STARTING, GENERATING, AND IGNITION APPARATUS; William B. Moses, Brookline, Mass. App. filed June 29, 1917. Special application to Ford cars.

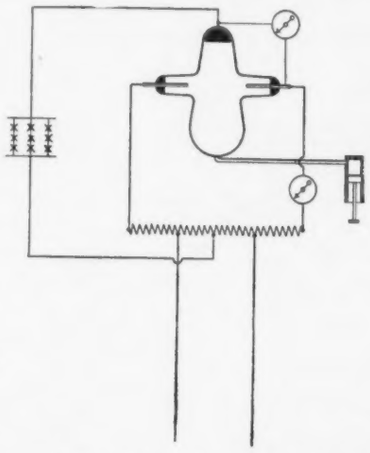
1,333,352. PULL SOCKET; George B. Thomas and Carl E. Anderson, Bridgeport, Conn. App. filed Aug. 25, 1914. Wide parting between switch terminals and switch plate.

1,333,359. SYSTEM OF ELECTRIC WELDING; David H. Wilson, Franklin Township, Bergen County, N. J. App. filed June 12, 1916. Maintains even amperage regardless of resistance and space across which arc must travel in making weld.

1,333,376. OSCILLATION GENERATOR FOR WIRELESS SYSTEMS; Milton Berel, New York, N. Y. App. filed June 20, 1918. High-frequency polarity reversing switch combination with source of current and a condenser whereby condenser terminals are reversed to produce continuous oscillations of radio frequency.

1,333,415. SYSTEM OF DIFFERENTIAL MAGNETIC TRANSMISSION; David C. Henry, New York, N. Y. App. filed Jan. 14, 1918. Controls slip by varying excitation of rotating fields and thus controls the speed.

1,333,420. INSULATOR BRACKETT; Charles C. Iles, Enterprise, Ohio. App. filed July 30, 1917. Supports twin wires and is attached to cross-arm by single fastening device.



No. 14,816 (Reissue). Method for Controlling the Efficiency of Mercury Rectifiers.

1,333,422. POLARITY INDICATOR; William Kaisling, Chicago, Ill. App. filed June 16, 1916. For ignition and lighting circuits of automobile.

1,333,427. LAMP AND REFLECTOR HOLDER FOR FLASHLIGHTS; Harry M. Koretzky, Brooklyn, N. Y. App. filed April 1, 1918. Special holder for reflector and light.

1,333,428. LAMP; Cecile Lafitte, New York, N. Y. App. filed June 5, 1919. Decorated lamp shade and holder.

1,333,452. DUPLEX METHOD OF AND APPARATUS FOR SENDING TELEGRAPHIC MESSAGES; Eugene S. Sandberg and Leland B. Newell, Springfield, Ill. App. filed July 21, 1917. Doubles capacity of a single-wire line for Morse telegraphy even when operated by a duplex machine.

1,333,458. ELECTRIC SEALER; Robert D. Sorver, Pasadena, Cal. App. filed Sept. 19, 1918. Sealing wax heated as used.

1,333,542. LIFTING MAGNET; Harry G. Geissinger, New York, N. Y. App. filed July 1, 1918. Reduces magnetic reluctance of idle gap and secures great tractive effort with minimum energy.

1,333,548. ELECTRIC IGNITER; Edmund J. Kane, Chicago, Ill. App. filed Jan. 14, 1915. Actuates oscillatory inductor of magneto for operating make-and-break contacts.

1,333,586. ELECTRICAL ARC-WELDING ELECTRODE AND PROCESS OF MAKING; Jack Churchward, New York, N. Y. App. filed July 21, 1919. Welding characteristics permit of rough handling.